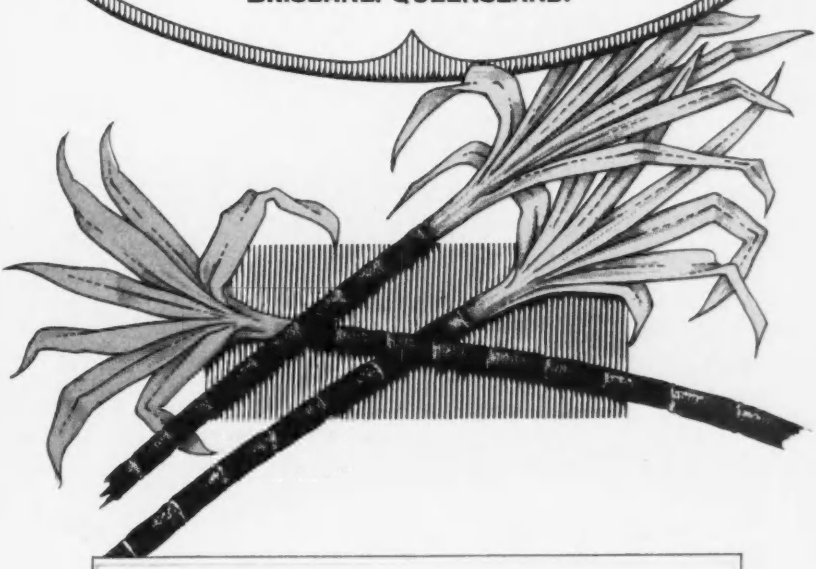
DEPARTMENT OF AGRICULTURE AND STOCK.

The CANE GROWERS' QUARTERLY BULLETIN

ISSUED BY
BUREAU OF SUGAR EXPERIMENT STATIONS
BRISBANE. QUEENSLAND.



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BLUE LUPIN AS A WINTER LEGUME.

BUREAU OF SUGAR EXPERIMENT STATIONS
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ISSUED BY DIRECTION OF THE
HON. F. W. BULCOCK, MINISTER
FOR AGRICULTURE AND STOCK

1 OCTOBER, 1938

DAVID WHYTE, GOVERNMENT PRINTER, BRISBANE

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The
Cane Growers' Quarterly
—Bulletin—

VOL. VI 1 OCTOBER, 1938 No. 2

Soil and Plant Interrelationships as Demonstrated by Soil Analysis.

By C. R. VON STIEGLITZ.

THE term "soil analysis" is heard so frequently, in reference to fertility investigations, that the uninitiated may be pardoned for concluding that this represents a certain fixed technical examination to which all soils are subjected, whatever the problem. It is also frequently assumed that such treatment will supply the complete answer to all soil problems, however complex. Unfortunately no method capable of yielding such spectacular results has yet been evolved, and the method to be adopted must be chosen to fit the problem. A soil analysis designed to give the "total" amounts of the various chemical substances comprising the soil complex, whilst of interest and help to a soil chemist in specialised investigations, tells nothing necessarily of the fertilizer requirements of the soil under investigation.

Special methods have been devised from time to time to determine what are called the "available" soil plantfoods, but although such methods in the past furnished results which separated soils of very high from those of very low fertility, little success attended the efforts to base fertilizer advice on the analytical findings.

This failure can be attributed to two main causes—

1. The fertilizer field trials, with which the analytical results were compared, were themselves unreliable, and
2. The sample submitted to the soil chemist for analysis was frequently not a true representation of the field under examination.

With the advent of statistical methods and their application to fertilizer field trials the outlook was completely changed, and it is now possible to carry out such trials confident in the knowledge that the results obtained will accurately assess the plantfood needs of the field under examination. Such an advance in field experimentation has supplied the chemist with that reliable information of the soil's reaction to fertilizer treatment which he previously lacked, and has paved the way to establishing a definite relationship between laboratory methods designed to show quantities of "available" plantfoods and the results of fertilizer field trials.

It has been possible also to devise new and less time-consuming laboratory methods, and to assess correctly their usefulness as a guide to fertilizer applications. During the past ten years the Bureau of Sugar Experiment Stations has been conducting scientifically designed field trials on selected farms on all the major soil types of the sugar areas. Such trials, however, are time-consuming and expensive, so that the desirability of obtaining similar results by reference to a soil analysis is obvious.

With this object in view, soil samples were taken from the "no fertilizer" plots of all experiments and analyses for plantfood availability carried out in the Brisbane laboratory by methods developed by the Bureau. By this means it has become possible to establish a good working relationship between the results from the field trials and the laboratory methods.*

Such a relationship, however, only exists when the sample for analysis is truly representative of the field under consideration and is taken during a definite period of the crop rotation. This correlation which has been established is based on the analysis of *samples taken just prior to or immediately after the harvesting of the plant crops of cane.*

A sample obtained at this period approximates most closely to the average state of the available plantfoods during the rotation.

It is a generally accepted fact that during fallow fresh soil particles disintegrate and decompose, and the supply of available plantfood, which has become depleted through the demands made upon it by the growing crop, is partially restored. Particularly is this so where a green manure crop has been ploughed under and allowed to decompose, thus helping to aerate the soil and supply the soil bacteria with the necessary energy to fulfil their function in building up anew the nutrient supply. The supply of nutrients, however, which is built up in this way, may be only transitory in nature and will largely disappear when the growing crop exerts its full influence. It will therefore be readily appreciated that soil samples for analysis taken immediately after a fallow period, are likely to give an exaggerated idea of the fertility of the soil, whereas one taken at the end of the first big growth period will express more nearly the power of the soil to supply plantfoods continuously.

Experiments on sampling carried out by the Bureau during the last three years have demonstrated that fields which appear uniform to the observer may vary very considerably from point to point in available plantfoods; and they have also shown how essential it is to exert the utmost care in sampling if the subsequent analysis is to mean anything. The Bureau will test soils for cane farmers free of charge, but any person submitting samples for analysis and fertilizer advice must endeavour to supply a sample which is as nearly as possible a true representation of the field in question.

It must be stressed that the instructions given below for the number of sub-samples which should be taken to form one composite is the minimum necessary; only good would result from increasing the number two or three times.

* These results have now been compiled by Dr. H. W. Kerr and the writer, and have been published as a Technical Communication of the Bureau.

Procedure for Taking Soil Samples.

A post hole digger is one of the most convenient implements with which to sample the soil, as this removes a complete portion in one operation. An ordinary 1½-in. auger is good, provided the soil is sufficiently moist to cling to it firmly. If these implements are not available, a square hole should be dug to a depth of 10 in. (plough depth) and after cleaning out the loose earth, a slice about 2 in. to 3 in. thick taken down one side from top to bottom. Such a sub-sample should then be placed on a clean bag or piece of canvas. Other sub-samples (of approximately similar weights) should be taken from other portions of the field and added to the first one on the canvas; all should be mixed thoroughly before making the final sample, which should approximate 2 lb. The number of sub-samples which should be taken and mixed in order to obtain such a representative sample will depend on the apparent variability of the soil and size of the field. At least three samples should be taken and composited for the smallest area. For large areas at least one sub-sample per acre is required.

Soils which appear markedly different must never be mixed, but each sampled for separate examination. Slight differences in colour, however, may be disregarded. *Fallow land should not be sampled except for special investigations.*

Notes should be recorded as to the type of sub-soil—e.g., sand, clay, &c.—and whether the area in question would be likely to benefit by artificial drainage, and these notes despatched, when the soil sample is forwarded to the—

Director,
Bureau of Sugar Experiment Stations,
Department of Agriculture,
Brisbane.

Samples should be taken from the middle of the interspaces just prior to or immediately after harvesting the plant crop but before fertilization for the ratoon crop.

A New Species of Legume.

In the April issue of the "Quarterly Bulletin" brief reference was made to experiments with a new leguminous species, bearing the formidable name *Crotalaria goreensis*. Arrangements have been made for further trial areas to be planted at our Experiment Stations and on selected farms throughout the cane districts, and in all probability more will be heard of this legume.

It is therefore desirable that it be endowed with a name which will be more readily pronounced and remembered by farmers. As it was imported from Gambia, Africa, it is proposed to call it the "Gambia Pea," and it will therefore be referred to as such in all future publications of the Bureau.

H.W.K.

Notes on Rat Baits, Rat Poisons, and Rat Population.*

By W. A. McDougall.

PROBLEMS connected with poison baits for rats can be conveniently placed in two groups; (1) those dealing with rats as *average* individuals, (2) those concerning rats as *a population*. It is proposed to deal chiefly with some aspects of group (1), viz., "median lethal doses" of the common rat poisons, bait bases, bait strength, and intake. Knowledge gained from a study of these portions of group (1) is one of the fundamentals for dealing with the second group, which actually covers possible control of rats in the field by poisoning. Unfortunately, the subject of rat populations, that is, the numbers of rats, kinds and ages of rats, condition and behaviour of rats in the field, is also of fundamental importance for a proper understanding of group (2). At the present time conclusions resulting from the early progress in our study of rat populations, and their application to the economic problem of rat control, must in some degree be a matter of opinion. They are given here as such.

Rat Bait Bases.

It is necessary that the few semi-technical terms used above should be explained at this stage. A "bait base" is a rat food into or on which a poison is placed. Bait strength denotes the proportion of poison to food in the bait. "Intake" means the amount of bait or food that an average rat may eat or can be expected to eat. We should distinguish between intake and take: intake is a true index of the palatability of a bait or food, whereas take, which could be called a field term, usually denotes the amount of material which is taken in the field. Obviously "take" depends upon a number of factors including bait or food palatability and the proportion of material offered to the number and weight of rats present. The "median lethal dose," or M.L.D. for short, is a term used for comparing the "deadliness" of different poisons. An M.L.D. of 250 means that a dose of 250 milligrammes of poison per kilogramme body weight of rat will kill 50 per cent. of the rats which eat it. It follows that a poison with an M.L.D. of 30 is ten times more deadly than one with an M.L.D of 300.

The field rat (*R. culmorum*) is predominantly a vegetarian, and foods which have been or may be used for bait bases could be listed in order of preference as follows:—rolled oats, a prepared food, cracked corn, corn, wheatmeal, whole wheat, barley, and bread. Rolled oats stands out above the others; barley is not a food particularly desired by the field rat, and there is always a poor intake of bread. For general purposes, the average field rat can be expected to eat approximately ½ oz. per night of an unpoisoned food such as wheat, and in the winter time as much as ¾ of an oz. The climbing rats (*Melomys littoralis* and *M. cervinipes*) which are smaller species, eat less. The actual

* These notes are a summary of two papers ("Improved Baits and Poisons for Rats" and "Rat Populations") contributed at a Conference of Cane Pests Destruction Boards, held at Meringa, on 25th May, 1938.

palatability of baits is not improved, so far as the economic aspect of baiting is concerned, by the addition of linseed or corn oil. These oils are excellent attractants, but they are not appetisers. It seems as if the fundamental fact governing intake is the palatability of the base bait as a food. Such intake is, in different degrees, modified by the several rat poisons at different bait strengths. We do not know of a material (called an "appetiser") which, when added to a poor bait base or a bait of poor intake, such as phosphorus on bread, will increase the intake.

Rat Poisons.

Having briefly discussed bait bases, &c., we shall now turn to the poisons. It has been found that, for our conditions, most of them can be dismissed very briefly. Red squills is variable in quality; the M.L.D.'s of samples used by us varied from 350 to 1,000. Arsenic (the sample used by us gave an M.L.D. of 200) gives very variable results. Zinc phosphide has an M.L.D. between arsenic and thallous sulphate, and of all the reputed rat poisons used by us, barium carbonate is the most useless from the point of view of its deadliness (M.L.D. about 1,000 at bait strength of 1 in 5). From a practical standpoint, all the above poisons together with the strychnines (probably the alkaloid is the best) and yellow phosphorus, tend to reduce bait intakes. The strychnines and phosphorus, however, are very deadly poisons. The effect of the strychnines on different rats is variable, but in general this poison is much more deadly than thallium. Phosphorus is easily the most deadly rat poison with which we have dealt. The small M.L.D.'s or extreme deadliness of these two poisons make up to a considerable extent for the small intake of baits containing them: this is particularly true for phosphorus. The successful administration of all rat poisons other than phosphorus, depends upon the intake of comparatively considerable, but variable, amounts of desirable foods. Phosphorus, on the other hand, is usually used on a cheap bait base (bread) with a very poor intake. Actually any successes with phosphorus and bread are due to heavy overdoses, accepted by the rats in very small intakes. Thallous sulphate, with an M.L.D. of approximately 35, is a very reliable poison. It is considered that, in the light of our present knowledge, and taking into account the numerous factors concerned, a bait strength approximating closely to 1 in 300 would be the best for thallium sulphate treated wheat in our cane fields.

Last year we had for our use a fairly uniform field infested by rats. We were able to obtain considerable information about the rat population in this field without reducing it in any way. There was very little migration, only one species of rat was present, and the relative sizes of the rats were such that similar behaviour could be expected from them all. It was found that a 62·4 per cent. take of ¼ oz. paketted, paraffin-coated, linseed oil sprayed, 1 : 500 thallous sulphate treated wheat, at the rate of 200 baits per acre, laid at ten yard intervals, had the same effect on reducing the rat population as a take of freshly prepared bread-phosphorus baits so small that it could not be calculated. It is not intended that this experiment be used to compare these two baits as rat controls. These baits are extremes in so far as intakes are concerned, but it is evident that it is futile to compare, on field takes,

the actual effectiveness of baits of different intakes. The reduction of the rat population to a degree sufficient to prohibit damage to cane is the chief criterion for the success of poisoning. A certain bait may give valuable results in the field. When it is known that the particular bait can do good work, its failures are not necessarily due to a shortcoming of the bait itself, which can be rectified. Very probably other good baits would fail also in the particular circumstances. This leads us to a consideration of rat populations.

Rat Populations.

Very often the popular conception of the subject of rat populations is limited to the question of how many rats per acre do we have to deal with to stop damage in our cane fields. No doubt the answer to this question is important, but we should be interested also in the kinds or states of population. For example: the destruction of a rat population consisting of non-migrating, reasonably even-sized rats at the rate of 100 per acre is much easier than attacking successfully a similar-sized population made up of small and large rats. Again, the damage to cane by a rat population of, say, 100 per acre is more easily prevented by poisoning in a field where this population has been born and bred, than in a field to which it has migrated.

In years when damage to cane by rats is most severe and wide spread in Queensland large rat populations are present. These are often called "plague" years, and during these years the rat population exhibits, besides "quantity," most of the difficulties associated with "quality" which could be encountered in rat control. At the present time, when there are not sufficient data available to help in forecasting rat plagues in cane fields, no recommendation can be made as to the best and most economic method of preventing or combating rat plagues.

In normal years nature takes a severe toll of rat populations between October and January. During this period large numbers of the heavier and older rats die off. With this in mind, and taking into account several other factors, including the small amount of rat damage in normal years and the remarkable recuperative powers of rat populations, it is considered that continuous and general all-the-year-round poisoning of cane fields and adjacent rat environments may not be economically sound. At least during normal years, attacks on the rats themselves or other direct methods of control, if necessary, might best be applied to localities where it is obvious that damage is occurring.

The Work of School Project Clubs.

THE Bureau has always warmly endorsed those aspects of Project Club work in rural schools which centre on simple fertility trials, as a means of demonstrating the value of special plantfood materials in cane production. There can be no better means of impressing the value of this phase of technical agricultural knowledge on the youthful minds of those who will be our future cane farmers.

An excellent demonstration is afforded by a fertility trial recently harvested at the Mossman Rural School. The area of land devoted to the purpose was sufficient to permit of 15 plots, each $\frac{1}{30}$ acre, to be pegged out, thus providing three plots each of the five standard treatments normally employed in this work.

The fertilizers were measured and spread by the pupils, who maintained close contact with the plots until they were harvested, and the cane weighed, while the calculation of the actual yields also afforded a useful exercise. The plant crop yields showed—

	Tons cane per acre.
"No fertilizer" plots	16·3
N P plots	22·6
N K plots	15·5
P K plots	21·1
N P K plots	22·8

From these figures it may be deduced that—

	Crop increase.
(N P K — P K) or (22·8 — 21·1)	= 1·7 tons due to N.
(N P K — N K) or (22·8 — 15·5)	= 7·3 tons due to P.
(N P K — N P) or (22·8 — 22·6)	= 0·2 tons due to K.

It is therefore evident that the soil is notably deficient in phosphate (P), which is remedied by applications of manures rich in superphosphate. The use of potash (K) has shown but little benefit, while the influence of sulphate of ammonia (N) has been quite definite. It should be pointed out that the area was green manured while in fallow, and therefore substantial results from sulphate of ammonia were not to be expected. It is interesting to record, however, that an application of this manure at the rate of only 60 lb. per acre seems to have improved the yield slightly.

G.B. and H.W.K.

The "Electric" Fencer.

A DEVICE which was recently brought on to the market, and which is attracting considerable attention from farmers, is the so-called "electric fencer." It consists of a small, compact unit, operated by a dry-cell or storage battery, which maintains sufficient pulsating voltage in the insulated wire of the fence to give any farm animal coming into contact with it a strong sting, which makes the animals wary of it thereafter. It is pointed out that the amount of electricity which flows, when contact is made, is so small that it cannot cause any harm to man or beast.

It is claimed that fencing costs can therefore be reduced substantially, as a single wire is sufficient to restrain all classes of farm animal, even the most persistent fence breakers. Moreover, ordinary barbed wire is suitable, supported by light stakes at intervals of 40 or 50 ft. apart. The wires are fastened to the stakes through small porcelain insulators, and it is stated that one unit will effectively charge 20 miles of insulated fence..

The stock are trained to respect the fence, by tempting them to come into contact with a charged wire; after one or two contacts, they will "leave it alone." Horses, cattle, and pigs are readily trained; it takes a little longer with sheep.

A dry-cell battery will remain effective for about two months, while a 6-volt storage battery would require recharging at about four to six week intervals.

The possibilities of this scheme have already attracted the attention of Cane Pests Boards, one of which is considering its value in keeping wild pigs out of cane paddocks. It is certainly an experiment which can be carried out very cheaply, and offers prospects of success. It may also prove useful in areas where wallabies are pests, and where netting would prove too expensive.

The cost of the unit without battery, is a few pounds, and we will be pleased to arrange for full particulars of the device to be forwarded to any interested canegrowers or organisations.

H.W.K.

The Use of Lime on Cane Lands.

By H. W. Kerr and G. Bates.

LIME of various kinds is a commodity which is widely used on many of the cane lands of North Queensland and, to a less degree, in the Central and Southern districts. Doubtless, there is much room for expansion in the use of this valuable material. But when the farmer attempts to choose the product best suited to his needs, and most economical in landed cost (on the farm), he frequently finds himself in difficulties. When it is remembered that lime costs in Queensland are very much higher than in most other countries, it is important that the purchaser be well informed on the subject.

What is Lime?

So-called "lime," or better, limestone or carbonate of lime, is a naturally occurring product, which may be found in any one of a number of forms, varying considerably in the proportion of worthless impurities they contain. One of the purest forms of lime carbonate is marble, a well-known, hard, crystalline material. Rock limestone, which lacks the granular appearance of marble, shells and coral are also composed of carbonate of lime, shells and coral being particularly free from impurities. A common form, which sometimes carries a fair amount of admixed impurity in the form of clay, is earthy lime or *lime earth* as it is sometimes called. It is quite a simple matter for the chemist to determine the purity or lime carbonate percentage of such materials, and, naturally, the value depends to a large extent on this factor; but there is another consideration which is most important, and that is the fineness of the material in its marketed form. Coarse particles are virtually useless for neutralizing soil acidity, and a good quality agricultural lime should consist for the most part of fine, dust-like grains, the majority of which will pass through a sieve with 100 meshes to the inch.

It is evident, then, that limestone, marble, coral, or shells must be finely powdered before they possess value as agricultural limestone; earthy lime, on the other hand, usually occurs for the most part in a finely-divided natural condition, though it may possess larger masses which must be removed by screening.

Provided these materials are of equal degrees of purity, and equally finely powdered, they possess equal agricultural value. The purchaser should therefore pay close attention to the *guarantee* which must appear on every bag of "lime" offered for sale; the label should show the purity (or *neutralising value*) and *fineness* of the material.

Burnt Lime.

Limestone in one or another of its several forms may, however, be subjected to burning before it is marketed. Due to this heating process the limestone is decomposed, giving carbonic acid gas, which passes into the atmosphere, and a residue of *burnt* or *caustic* lime. Actually 100 parts of pure limestone lose 44 parts of carbonic acid gas, leaving 56 parts of rock-like burnt lime. An important feature of the process is that a product is obtained which is more "concentrated" than the original limestone, and is therefore less costly to transport.

When burnt lime is wetted, it swells and heats, and finally crumbles to a finely-divided substance known as *slaked* or *hydrated* lime. A suspension of slaked lime in water is used by the sugar mill to purify the cane juice in the clarification process. If, on the other hand, a lump of burnt lime be exposed to the air, it slowly "grows" in size and crumbles once again to a very fine powder. The latter reaction is actually a reversal of the burning process, and is known as *air-slaking;* 56 parts of pure burnt lime again absorb 44 parts of carbonic acid gas from the air to restore the 100 parts of carbonate of lime. This process also takes place in the field when burnt lime is allowed to lie on the land surface for a few days.

Now, it is generally recognised that burnt lime is quicker in its action than crushed limestone; and it might be asked why this should be so, if air-slaking converts burnt lime once again to the form of carbonate, before it is spread. The answer lies in the fact that the carbonate of lime thus formed is extremely finely subdivided, and owes its virtue exclusively to this factor.

Assessment of Values.

The farmer should now be able to appreciate the differences to be sought when considering alternative forms of liming material. The *neutralising value* may vary from 70 or 80 per cent. (with some classes of impure earthy lime) to 100 per cent. with the purest crushed limestone, and as high as 160 per cent. with pure forms of burnt lime. The fact that burnt lime may be equal to much more than "100 per cent." lime carbonate is due to the concentrative influence of burning. It should be remembered, however, that not all burnt lime is so high in quality as this. Some limestone is imperfectly burned and still contains chunks of raw material which will not, of course, slake; while the ashes, or charcoal from incompletely burnt firewood, may be present as new impurities.

Besides purchase price at the factory or lime works, the farmer must also consider the freight over the railway in transporting the lime to the nearest siding, and the cost of cartage to the farm. Burnt lime possesses a decided advantage in this respect, while impure limestone or earth lime may lose any advantage in first cost when freight and cartage on the worthless impurities are added.

Objection to Burnt Lime.

Many farmers object to the use of burnt lime because of its caustic properties before it is air-slaked. Moreover, if the bags should become moist, there is the risk of bursting due to the slaking process which ensues, and the great heat which is thus generated may result in fire. Burnt lime, when handled in wet weather, should therefore not be stacked in a shed containing tractors, kerosene, benzine, or other inflammable matter.

When handled carelessly, burnt lime will also result in serious burning of the skin, often necessitating a sojourn in hospital. A liberal coating of grease applied to the exposed parts of the body will not only prevent injury but will make it easier to remove the adhering lime later.

The use of a good-type distributor for spreading slaked lime on the land is certainly to be recommended for both speed and personal comfort. It is also a decided advantage in giving a rapid and even distribution of the harmless, non-caustic carbonate of lime or earthy lime. Certain firms marketing lime now include the use of a distributor in their purchase terms.

What is Dolomite?

Many farmers have heard quite a lot of recent months regarding a form of lime known as *Dolomite*, and for which many extravagant virtues have sometimes been claimed. Dolomitic limestone is simply a limestone containing a greater or less proportion of carbonate of magnesia. In neutralizing soil acidity, the two materials act very similarly, and in general, dolomitic limestone—provided it is of high purity and is finely pulverised—may be given a value equal to that of a good quality agricultural lime.

It might possibly possess added value on soils which are deficient in the relatively minor plantfood, magnesium. During the past year the Bureau has attempted to discover whether any major Queensland soil types exhibit a deficiency in this respect. Although applications of magnesia have been made in about twenty trials, in no case has any benefit been observed. It is therefore evident that soils deficient in magnesia are not common in the cane belt; indeed, it was formerly considered that many Queensland soils contained excess of magnesia, and that applications of lime were necessary to balance this condition.

When is Liming Necessary?

Lime may be applied by the farmer for one of two purposes; either because his land contains harmful amounts of soil acidity, which hinder normal root growth, or his land is "heavy" and "sour," and he wishes to improve its physical condition and "sweeten" the soil.

A rapid chemical test, performed either by the local Instructor in Cane Culture, on request, or in the laboratories of the Bureau, will readily demonstrate whether the soil is excessively acid. Not all soils are in this condition, while certain types—such as true red volcanic loams—seldom, if ever, require liming. Therefore it is a wise precaution for the farmer to follow this practice; and it should be remembered also that some very well-drained lands are actually very acid, and waterlogging is not a guide in this respect.

Finally, the chemical test for acidity bears no relationship to the value of lime for "opening-up" a tight soil; the probable value of lime for this purpose is left to the discretion of the farmer.

The Agricultural Value of Rotary Filter and Subsider Muds.

By H. W. Kerr and C. R. von Stieglitz.

IN earlier days, the mud settlings which were produced when the raw juice was limed, were treated in filter presses to remove the sweet juice they contained. The cake from the presses possessed a substantial fertilizer value, and spectacular results were often produced when the material was applied in heavy dressings to worn-out fields, or lands of naturally low fertility.

The cake contains a number of ingredients of greater or less fertilizer value. Firstly, any soil or dust adhering to the cane finds its way to the bottom of the subsider, while a fair proportion of fine bagasse particles are also entrained and settle out of the juice. Then there are the products of chemical reaction between the milk of lime added for clarification purposes, and the constituents of the juice. One of these is phosphate of lime; another is the protein-like matter which is coagulated by heat and lime treatment and precipitated in the mud.

The dried mud therefore contained, as a rule, about 50 per cent. of soil-like material, and an equal amount of "organic matter," much of which was potential humus-forming material which possessed a distinct value when incorporated with the soil. As regards plantfoods, the following is a fair average composition of *dried* filter-press cake:—

	Per cent.
Nitrogen	1·5
Phosphoric acid	2·25
Potash	0·25
Lime	3·0

It should be noted that this refers to material which has lost its moisture. Actually, the cake as discharged from the filters contains about 50 per cent. of moisture, so that the plantfood composition of the fresh material would be practically one-half of the values given above; a conservative estimate of the value of such material, at least on lands deficient in phosphate, would be about 7s. 6d. per ton.

In recent years, however, the filter presses were largely discarded when the Killer process of mud disposal was introduced. The so-called "Killer mud" was, of course, identical in composition with that of the press cake, except that it contained very much more moisture. While press cake contained 50 per cent. of dry matter, the Killer mud had only about 10 per cent., and therefore its value, as discharged from the subsiders, was only about 1s. 6d. per ton. Cost of transportation of such wet material would therefore render its use uneconomic, unless steps were taken first of all to remove some of the excess water. This has been effected with success by providing broad, shallow earth ditches, into which the mud could be discharged and allowed to remain while much of the moisture filtered through the earth bottom or evaporated from the surface. After a period the mud approximated to the composition of press cake, when it could be dug out and carted to the fields. This practice is still followed at certain mills, and is satisfactory where the subsoil bottom of the storage ditches is porous in nature.

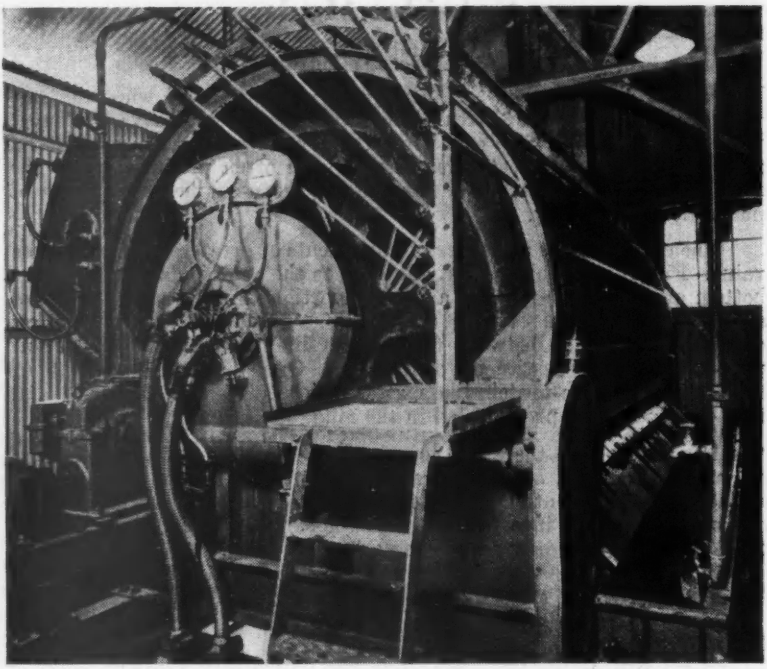

Fig. 8.—Illustrating the newly-introduced rotary mud filter.

The most recent development in mud disposal is the rotary filter, which has virtually become standard equipment in the Queensland mills. The sweet juice is removed from the muds by suction, the filtering medium consisting of the fine bagasse particles which are obtained by screening, and are added to the mud. The by-product from these filters contains, as a rule, about 70 per cent. of water, or 30 per cent.

of solid matter. It is therefore intermediate in quality, from an agricultural point of view, to Killer mud and press cake. It differs from these, however, in respect of its content of fine bagasse. The latter is rather poor material from the viewpoint of fertility building, though it may eventually give rise to humus after decomposition in the soil. It must therefore be regarded rather as something which "dilutes" the mud or adds to its bulk without supplying much of direct plantfood value.

Recent analyses of filter muds, calculated on a moisture of 70 per cent., give the following approximate composition to the material as discharged from the filter:—

	Per cent.
Nitrogen	0·5
Phosphoric acid	0·5
Potash	0·06
Lime	0·7

An estimate of the plantfood value of such material, on the farm, would be about 4s. per ton. It is therefore evident that mud from the rotary filters could be used economically only where it can be handled expeditiously and where short haulage distances are involved.

There can be no doubt that filter muds should rightly be returned to the land, to restore a large proportion of the fertility removed with the cane. But it obviously is not good economics to spend 5s. to produce 4s. worth of value. It would be better to purchase the equivalent of fertilizer, and restore humus-forming material to the soil through the medium of trash and green manure crops.

A further point worthy of consideration in evaluating mud is the class of soil on which it is to be used. Nitrogen is of value on all soil types; lime is useful on alluvial and other acid types of soil, but of little worth on red volcanic loams; the last named also derive little benefit from phosphates, though these are extremely important for many alluvial lands. It might therefore be stated that the values as estimated above would be applicable to alluvial or other acid, phosphate-deficient lands, while for red volcanic soils the value would be much less.

As regards applications per acre, it will be found that from 15 to 20 tons of material, as it leaves the filter, will prove satisfactory. It is of most value when applied to fallow land or old ratoon fields just prior to ploughing out of the stools.

Sugar Display at the Brisbane Show.

THE Sugar Industry Display at the Royal National Show held in Brisbane from the 15th-20th August last, again attracted interest and favourable comment from those who viewed it. The accompanying illustrations (Figs 9 and 10) show the general arrangement of the exhibit, which was similar in most particulars to that of 1937.

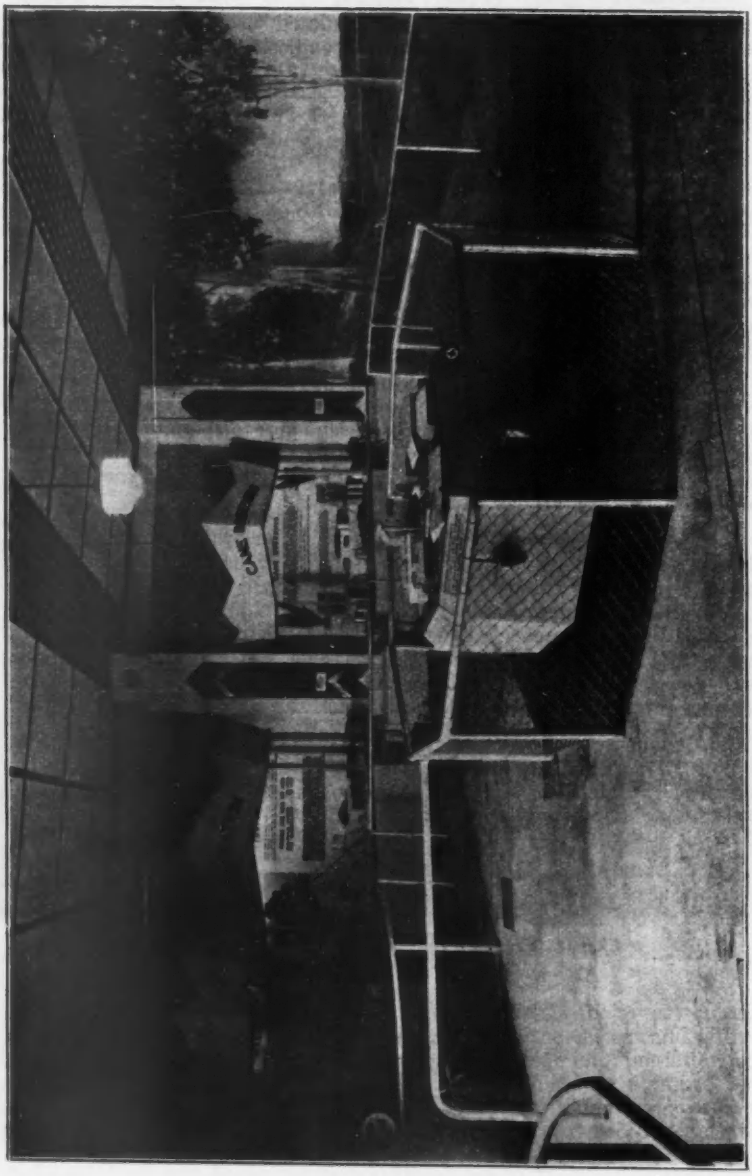

Fig. 9.—General side view of the Sugar Court display.

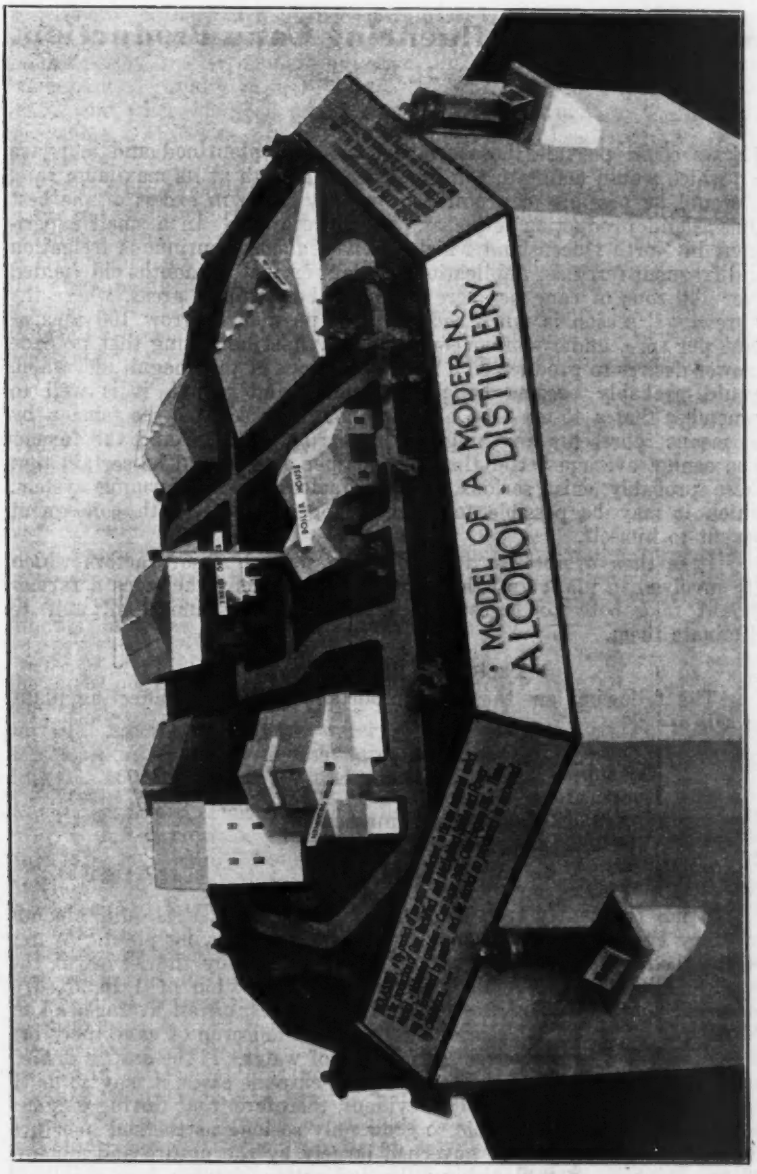

Fig. 10.—Showing details of the model distillery and description of the process.

The central octagonal display, which was occupied last year by a pond with specimens of the Giant Toad, was replaced by a model illustrating the layout of a modern alcohol distillery. The accompanying samples of the several products and by-products, together with the descriptive matter, enabled the process to be followed very readily. The model was based on the actual layout of the new distillery erected at Bundaberg.

H.W.K.

Some Factors influencing Cane Production.

By H. W. Kerr.

Introduction.

IF we could provide those conditions of soil plantfood and moisture which would maintain continuous cane growth at its maximum rate, it would be possible to produce crops very much in excess of the best Queensland production levels at present recorded. In a small experiment in North Queensland which received almost continuous irrigation and frequent fertilizer applications, a plant crop at 18 months old yielded over 140 tons of cane per acre; even in the southern areas, where the "growing" season is much shorter, it is possible to grow 100 tons of cane per acre, under similar conditions. Whilst admitting that no cane grower desires to produce on a field scale crops of this magnitude, which would probably become hopelessly lodged and rotted, it is well to remember that a 45-ton crop of cane, though pleasing to the farmer, by no means represents anything like a *maximum* yield; and the farmer who cannot average better than 20 tons per acre should be certain that there probably exist serious limiting factors, in his farming system, which it may be possible to overcome or eliminate, with consequent benefit to himself.

It is then of interest to record the several major factors which are involved in plant growth and to indicate briefly the steps a farmer should take both to investigate causes of crop limitation, and to eliminate them.

Factors in Crop Growth.

The following are the most important soil factors affecting plant growth:—

1. Water supply.
2. Air supply.
3. Temperature.
4. Supply of plantfoods or nutrients.
5. Various injurious factors.

1. Water Supply.—

It has frequently been emphasised—and indeed, it is quite obvious to every canegrower—that sugar cane is a water-loving plant. Water is absorbed by the crop roots, and is evaporated by the leaves of the cane. It has been estimated that in the production of 1 lb. of *dry* material, the cane plant absorbs and evaporates, on an average, about 30 gallons of water. The production of a 30-ton crop of cane therefore necessitates access to about 45 acre-inches of water. If the crop is denied ample soil moisture, growth ceases, and in extreme cases, it may actually perish from drought. It will be evident, therefore, that during rainless periods, the cane crop is able to grow only so long as the soil moisture supply lasts. This will be governed largely by the nature and amount of the rainfall, in replenishing the soil water supply; but it is well known that a "heavy" soil (clay or clay loam) holds moisture better than a "light" or sandy soil, and therefore crop growth is more regular on the heavier type, because of the superior moisture supply. Moreover, crops growing on heavy soils make more economical use of water than do those on sandy soils.

Where the normal incidence of rainfall is such as to cause serious checks to cane growth, the only satisfactory method of overcoming the trouble is by the artificial application of water. Irrigation practice has expanded rapidly in many of the drier areas of the State in recent years: and wherever good quality water can be brought to the field at reasonable cost, costs of cane production have been reduced very materially.

It has been pointed out from time to time that the humus content of the soil is an important factor governing the moisture retentive power of the soil. Therefore the farmer can attempt to effect some improvement in a droughty soil by ploughing in all crop residues—trash and tops—and green manuring the land when in fallow. Deep working of the land by means of the subsoiler or grubber will also assure the maximum absorption of moisture in time of heavy rainfall, and also permit deep penetration by crop roots to get access to the moisture so stored.

It is also possible to minimise the loss of moisture by evaporation from the moist land surface by conserving trash as a surface mulch in ratoon crops. In a dry year particularly, this has frequently been attended by striking results.

2. Air Supply.—

Though the cane crop roots require an abundant water supply, they must also have air for their healthy growth and development. Without air the roots cannot "breathe," and are unable to perform their normal function of water and plantfood absorption.

It is therefore essential that the farmer pay special attention to the question of land drainage. During heavy rainfalls, the air is temporarily driven out of the soil, and all interspaces between soil particles become filled with water. When the rain ceases, however, it is essential that the surplus water drain freely, so as to restore the desirable condition of an aerated, moist soil.

It is a fact that many of the Queensland cane soils which cause the crop to suffer most in rainless periods, also become water-logged in times of heavy rain. The situation may be improved in a number of ways. An adequate system of surface drainage will enable excess water to be removed from the surface of the land, and relieve the burden of sub-drainage in the soil. But this is only partially effective if the subsoil strata are of such a character as to be impervious to water; under such conditions, the only means by which the excess can be eliminated is by evaporation from the land surface, and this is not satisfactory. The breaking up of hard pan layers and the installation of a system of tile drains is the only satisfactory means of guarding against long periods of waterlogging in such a soil. They are costly, but effective. The mole-drainer may be helpful, but it gives satisfactory results only where the subsoil clay is of suitable character. Deep grubbing or subsoiling has given good results on certain soils, notably where the existence of a compact plough pan is the cause of excessive water retention by the soil.

The farmer should make a careful examination of any fields in which waterlogging occurs, and apply the appropriate remedy, if at all possible. An over-wet soil may be responsible for just as great crop losses as one which is droughty.

3. Temperature.—

The temperature of the soil (and air) are of importance to cane growth. It has been demonstrated that crop growth is virtually at a standstill, so long as the average daily atmospheric temperature is less than 65°F. This is true, no matter how favourable all other growth conditions may be. When the mean temperature rises to 70°F., vigorous growth becomes possible, while for temperatures from 75° to 80°F.,

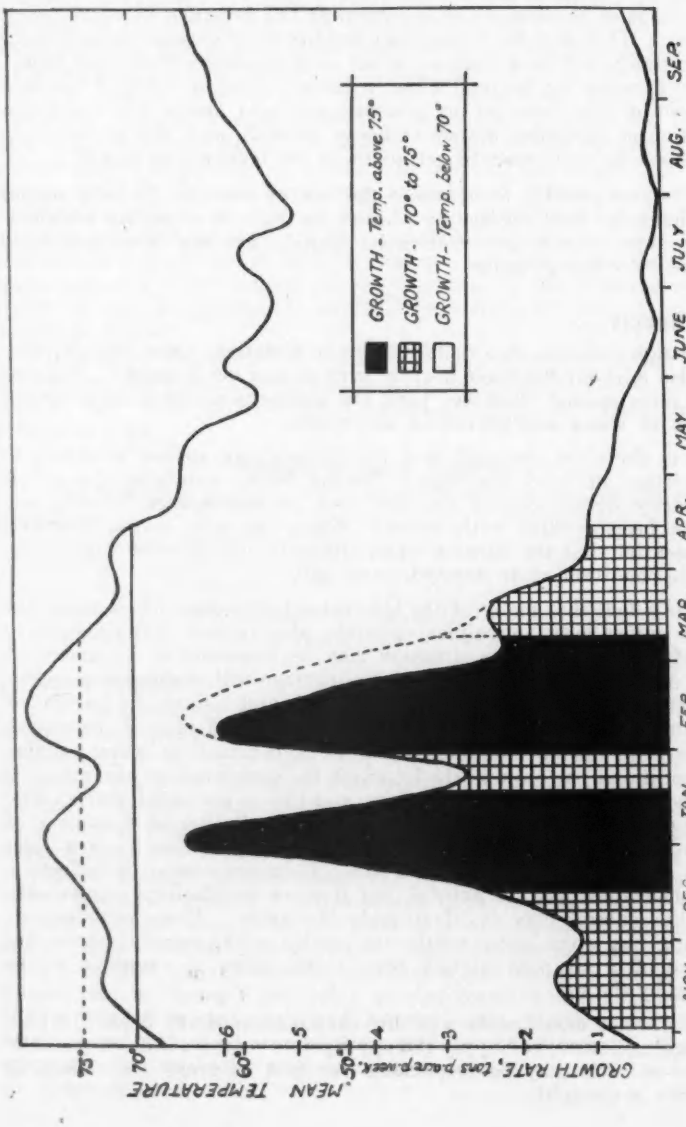

Fig. 11.—Illustrating the close relationship between cane growth and mean atmospheric temperature; irrigated cane.

crop growth can proceed at a very rapid rate. Of course, other factors incidental to temperature enter to modify this generality. Excessively hot, dry winds would result in a high average temperature, but it is known that they tend to distress the crop, rather than favour its development.

On the basis of soil and atmospheric temperature, then, stands the explanation of the longer growing season experienced in the far north, as compared with that in the southern areas; and other things being equal, one should expect potentially heavier cane tonnages per acre in the tropical regions than in the more temperate zone.

A subsidiary factor, which might be mentioned in this connection, is that of sunlight. Though this is beyond the powers of the farmer to modify, it is important to note that for a given mean temperature, cane growth is more vigorous in bright sunshine than in cloudy weather. Moreover, the greater length of the summer day in southern, as compared with northern Queensland, offsets to some extent the handicap of a shorter growing season.

4. Supply of Plantfoods.—

The cane crop develops by the process of manufacture of plant tissues from raw materials which it obtains from the soil and air. The two major raw materials are water and carbon dioxide gas, which are combined by the green colouring matter of plants, in the presence of sunlight, to give first of all simple sugars, which become the building stones from which more complex tissues are constructed. But this process can only proceed so long as the plant obtains its balance of mineral elements and nitrogen compounds from the soil. These are the so-called "plantfoods" which the farmer must jealously guard and maintain in the soil.

Plantfood deficiencies are probably responsible for greater reductions in crop yield than any other factor except soil moisture. This is notably true in the regions of high rainfall where leaching is excessive, and the soils, even in their virgin state, possess relatively poor supplies of these important substances. So long as the land is maintained in permanent cultivation, the liberal use of artificial manures is the only means of maintaining or building up the reserves of the soil. The policy of long fallowing under grass, combined with the growth of green manure crops, is a slower but more economical method of effecting the same result. Doubtless it is a distinct advantage if both methods can be combined judiciously. Crop rotation in itself leads to other benefits which cannot be discussed in detail here, but which have been dealt with previously.

The plantfood requirements of the major cane soil types of Queensland are the subject of continuous investigation by the Bureau, and each year a number of fertility trials are harvested from selected farms in all cane areas. The information thus gained, when applied intelligently, enables farmers cultivating soil of these particular types to purchase those fertilizer mixtures which will give the maximum return for a given expenditure. For more highly specialized advice, an analysis of the soil should be sought. This service is provided at no cost to the cane-grower, and if desired, the local Instructor in Cane Culture will visit the farm, on request, and take the necessary samples of soil for the purpose. This is a service which could be availed of much more completely than it is at the present time. Fertilizers are costly, and the purchase of the wrong balance of foods may lead the farmer into much unnecessary expenditure.

5. Various Injurious Factors.—

There often exist in the soil substances which are actually harmful to the cane crop. One of the chief of these is soil acidity. Due to excessive leaching of lime and similar substances, there develop in certain soils concentrations of acidity which are definitely harmful to the crop roots. Cane normally thrives in a soil with a slight intensity of acidity; but when a certain maximum value is exceeded, the falling off in crop growth proceeds at a rapid rate, while extreme instances have been recorded where cane growth was not possible. The remedy for this trouble is the application of suitable amounts of liming materials—either crushed limestone, earth lime, or burnt lime. The need or otherwise for this treatment can rapidly be determined by a simple test, and growers desirous of advice in this connection should consult the local Instructor, or forward a sample of soil for the purpose to the Head Office of the Bureau, or to one of the experiment stations. This knowledge is important, for it is well recognised that fertilizer applications do not produce the full possible benefits on soils which need liming to destroy acidity.

Fig. 12.—Illustrating the effects of soil erosion; ten years previously this field produced good crops of cane.

Where irrigation is practised, soils and crops are sometimes damaged due to the presence of harmful salts dissolved in the water. Brackish waters may lead to an accumulation in the soil of common salt, which builds up to such an extent that crop growth is seriously affected. This occurs most frequently on soils which do not possess adequate subsoil drainage. The obvious remedy is either to promote better drainage conditions, or to avoid using waters of excessive salinity. No water should be used for irrigation purposes until it has been analysed by the Bureau, and declared safe. A more dangerous salt which often occurs in the sub-artesian waters of the Burdekin district is carbonate of soda, or "free alkali." This substance is much more troublesome than ordinary salt, and its effects on both soil and crop may be very serious. Water analysis readily demonstrates the presence of soda, and if the grower is unable to fined a supply free from this ingredient, he should at least guard against permanent damage to the soil by taking the necessary precautions. The use of lime is often helpful in this regard, while applications of gypsum (occurring also in superphosphate), sulphate of ammonia or sulphur will readily overcome the effects of moderate amounts of free alkali.

In certain areas adjacent to the coast, canelands are inundated by high tides, and the salt which remains in the land after the tide has receded and the soil water evaporated, may reach injurious proportions. In such cases, an attempt should be made to prevent ingress of salt water, while lands so damaged may again be restored to a state of fertility when the salt has been washed out by rains. Sub-drainage is, of course, essential if the salt is to be removed effectively, and supplementary treatment with gypsum, lime, or sulphur may be necessary to improve the physical conditions of the soil.

Fig. 13.—The poor stand of young cane was due to the removal of surface soil from the hillside, by erosion.

Amongst "injurious factors" might be classed pests and diseases of sugar cane. The farmer should be continually on his guard against the presence of these factors; and although it is not expected that he will be able to recognise and identify all of these, or even diagnose the trouble when it occurs, he should at least be able to detect that the trouble is due to some such biological cause, and invoke the aid of the experiment station officer to assist him.

This is particularly important in the case of cane diseases; at the present time the Southern cane districts are seriously threatened by Fiji disease, and the chief difficulty with which the Bureau has to contend in eradicating this trouble is to find out where the disease occurs, so that steps may be taken to prevent its spread. The wisest course for the farmer to follow in matters of this nature is, then, to report immediately to the nearest experiment station anything whatsoever of a suspicious nature. An early visit from an officer will then reassure him, or advise what must be done to correct the situation.

Other Causes of Depleted Yields.

It would be possible to list and discuss a number of causes of local soil troubles, but this cannot be attempted in detail. There are, however, two important factors which growers may completely over-look. The first is *Soil Erosion*, leading to loss of plantfoods and general fertility, and the second is *Faulty Subsoil Conditions* which result in extreme droughtiness of the land.

Soil erosion is, fortunately, not a matter of serious general occurrence in the cane districts of Queensland, but on certain hillside areas in regions of high rainfall, it has been responsible for substantial losses. In parts of the Innisfail district, farmers on red volcanic soils often find that the productive capacity of the soil falls off at a rapid rate for no very obvious cause. They will agree that "soil washing" occurs, but as the subsoil in such areas is generally very similar in colour and appearance to the surface soil, the loss of the richer surface layer is not detected, and the mischief is done before its true significance is realised.

Fig. 14.—Showing a badly "washed" area on which the cane cannot survive, due to the removal of the surface soil.

Measures for overcoming soil erosion have been discussed in earlier issues of this Bulletin. At this time will be recorded only those measures which have been found most effective in dealing with the trouble. Ordinary applications of artificial manures are of no avail in restoring fertility in such circumstances, and the only effective and economical method is to apply heavy dressings of mill by-products—mud, molasses, and ashes. This practice is now being followed with excellent results in the South Johnstone area. Green manuring, and trash conservation (as a surface mulch) in ratoons, are also two factors which will assist the farmer.

A case was recently reported where cane on an apparently fertile area suffered very severely during dry weather, for no obvious reason. An examination by the instructor in cane culture showed that at a depth of two feet the soil was underlain by a deposit of water-worn stones and gravel, indicating the earlier existence of a watercourse in this locality. The cause of crop distress was thus made evident; such a layer of coarse material possesses little powers of water retention, even after the heaviest rains, and the crop was obliged to subsist on just so much moisture as the surface soil was able to hold. Unfortunately, there are no practical means of correcting such a difficulty.

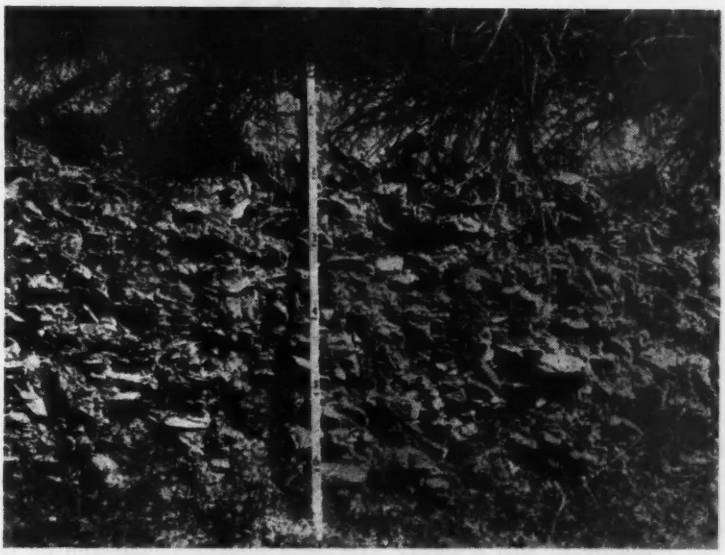

Fig. 15.—Illustrating a bed of water-worn stone and gravel below 2 feet of soil.

Conclusion.

It is hoped that this discussion may stimulate cane farmers to make a more detailed study of the factors operating in their locality to make or reduce crop yields. The farmer should know his own conditions intimately, and it is generally unwise to blame any one cause for growth failure, until all possible causes have been investigated.

Rubber Tyres for Farm Machinery.

By H. W. Kerr.

FARM TRACTORS.

THE use of rubber tyres for farm tractors is rather a new development which would appear to have prospect of substantial expansion in the near future. Low-pressure tyres of this class were introduced to Australian agriculture in 1934; they usually carry 10 to 12 lb. of air pressure in the rear and 24 lb. in the front-wheel tyres.

This equipment has been extensively studied by certain of the Agricultural Experiment Stations of the United States, and it may be of interest to Queensland canegrowers to review some of the conclusions reached at Ohio.

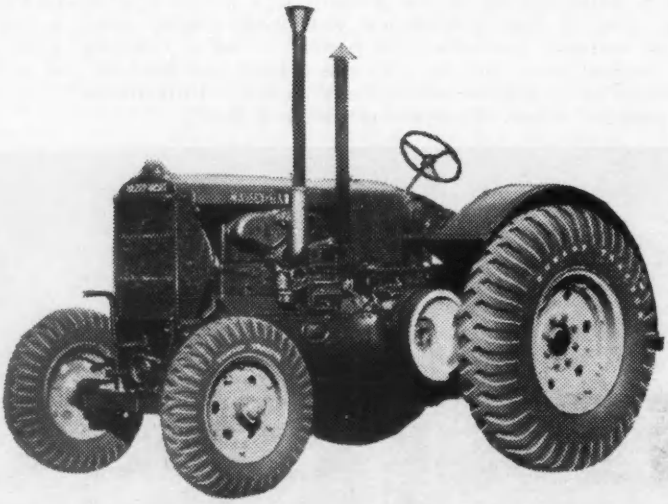

Fig. 16.—Showing a tractor equipped with pneumatic tyres.

Rolling Resistance—Steel Wheels with Lugs *v* Pneumatic Tyres.

The tyres used in the tests were 11·25 × 24 rear and 6·00 × 16 front. The significance of this test is that the lower the rolling resistance, the less power will be required to move its own weight over the ground, thus resulting in fuel economy. On both ploughed land and on sod, the rubber-tyred tractor required substantially less power to move it than did the same tractor with steel wheels. The reduction in power was of the order of one-half, and it is interesting to note that the rolling resistance of the rubber-tyred tractor on ploughed ground was less than that of the steel-wheel tractor on sod.

One of the major reasons for the differences lies in the fact that power is consumed in forcing the lugs into the ground and removing them as the tractor moves onwards. The force required is, of course, greater on grass land than on ploughed land.

Fuel Consumption—Steel Wheels with Lugs *v* Pneumatic Tyres.

The tractor was in this case required to pull a subsoiler at different depths and various rates of travel. The rubber-tyred tractor showed a lower fuel consumption in practically all tests. Only on ploughed land, at light draw-bar pull, was the steel-wheel tractor superior. Moreover, the rubber-tyred tractor operating in third gear had greater fuel economy than the steel-wheel tractor in second gear. The greater draw-bar pull of the former was due to the much reduced slippage which was experienced.

Summarising all tests (with tractor operating uniformly in second gear, on sod and ploughed land), the average fuel consumption for the two units was—

Rubber-tyred .. 1·84 lb. per hour per H.P. at draw-bar.
Steel-tyred .. 2·02 lb. per hour per H.P. at draw-bar.

When the rubber-tyred tractor was operated in third gear, the disparity in fuel used was even greater.

Ploughing Test—Steel Wheels with Lugs *v* Pneumatic Tyres.

The results of this test are summarised in the following table:—

	Steel wheels.	Rubber tyres.
Area ploughed	0·79 acre	0·79 acre
Depth of ploughing	6·89 in.	6·82 in.
Time taken	45·1 mins.	35·3 mins.
Rate of travel, miles per hour	3·53	4·50
Fuel used—pounds	12·8	9·7
Fuel used—pounds per acre	16·3	12·3

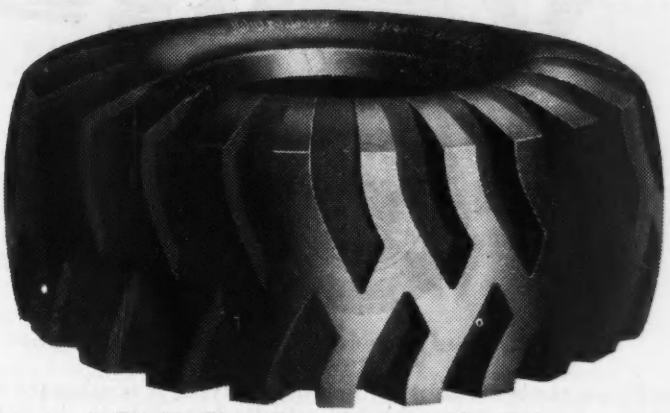

Fig. 17.—Illustrating a tractor rear rubber tyre.

The ploughing was carried out on a field of mixed lucerne and grass sod. Very little trouble was experienced in securing sufficient traction with the rubber tyres, even in the mornings when the grass was wet and the soil somewhat slippery. It was, however, necessary to change the hitch on the plough to cut the desired width of furrow.

It was also found that a greater maximum draw-bar pull was provided by the tractor with rubber tyres than with steel wheels and lugs. The superiority of the rubber-tyred tractor was more pronounced at higher speeds.

LIFE OF RUBBER TYRES.

Observations made on a tractor which had been operated for 1,349 hours, on all manner of farm work, showed little sign of abrasive wear. They suffered most wear by chipping, though this was not serious, and was due to contact with sharp stones. During the period, the rear tyre decreased in weight from 98·3 to 94·3 lb.; the front tyre decreased in weight only ½ lb. Only two punctures were experienced.

GENERAL OBSERVATIONS.

The amount of dust raised in dry soil is much less with the rubber-tyred tractor. Under most conditions it also rides easier, though in badly ridged land it "bounces" considerably. This can be overcome by inflating the rear tyres slightly. Rubber tyres also pick up less material than do the steel wheels with lugs.

It is concluded that for most farm operations rubber tyres are very satisfactory. They are especially desirable for transportation work (or travelling over roads where grips must be removed from steel wheels). Where land is wet or sticky, chains may prove of some assistance to the rubber tyres, but it is better to stay off such land.

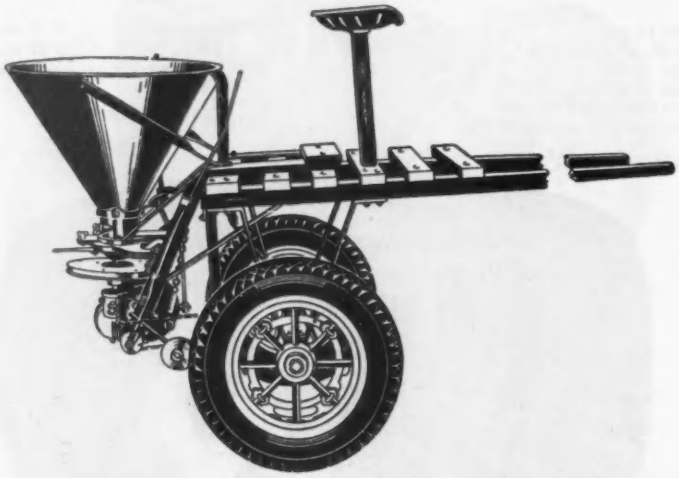

Fig. 18.—Illustrating a lime distributor equipped with rubber tyres.

To get the best results with pneumatic tyres, it is necessary to add weight to the rear tyres; this had actually been done in the tests discussed above. For a tyre 11·25 × 24, for example, the weight per wheel should be not less than 750 lb. A very useful and convenient means of effecting this is to apply weight in the tyre by means of water. This is done by filling the tube up to half-full of water, and inflating the remaining space to normal operating air pressure.

FARM WAGGONS AND TRAILERS.

Though many horse-drawn commercial delivery vans equipped with rubber tyres have been in use in North Queensland for many years, the idea has not been adopted to any extent by canegrowers. Combined with the use of rubber-tyred tractors, it is probable that such waggons and trailers will be more widely employed in the future for such purposes as cane carting, when the need for a motor truck may be largely displaced.

It has been found that, due to the larger bearing surface of rubber tyres over the steel tyres of the ordinary farm dray, there is less penetration of the surface and hence a lower tractive power required. On

carefully conducted tests, the following tractive power was required for comparative loads:—

	Power required—	
	Over grass.	Over soft ground.
	H.P.	H.P.
Wheel with iron tyres	1·1	1·9
Wheel with pneumatic tyres	0·6	1·4

The rubber tyre also causes less damage to pasture land than does the iron rim.

Fig. 19.—Showing a waggon fitted with pneumatic rubber tyres.

An important feature of the rubber-tyred vehicle is its low construction, due to the smaller wheels. This greatly facilitates loading and discharging. It is interesting to note, also, that in the tests made, roller bearings did not offer much advantage as regards tractive power—the rubber tyre was the most important factor.

Downy Mildew in Southern Queensland.

Downy mildew in the Southern areas is at present confined to the Bundaberg district, and is to be found on the Barolin road, and scattered through that part of the Millaquin and Qunaba area on the eastern side of the Ashfield road, extending from the Barolin road to the Burnett River. In the Bingera mill area, small outbreaks are to be found at Hill End (South Kolan), and along the river at South Bingera.

Under favourable conditions of temperature and moisture, such as are usually experienced from December to April, the spread of this disease is very rapid. Growers are therefore urged to make very careful inspections of young plant and ratoon cane, and dig out any yellowish, or suspicious-looking stools of cane. The disease is also spread by planting diseased material, and great care should be exercised in the selection of planting material in the areas mentioned above.

Any growers not familiar with the disease should get in touch with the Officer-in-charge of the Bundaberg Sugar Experiment Station. If the disease is present in small amounts only, and the canes affected are dug out early in the season, there will be no need for plough-out orders in such blocks. Growers should, therefore, not fail to report the disease, because of fear of a plough-out order. Two of the main canes grown in the area, namely P.O.J. 2878 and P.O.J. 213, are very susceptible to downy mildew disease, while P.O.J. 2725 is resistant, and Co. 290 appears to be resistant under Bundaberg conditions. C.G.S.

Varietal Trials.

RESULTS FROM FARM EXPERIMENTAL PLOTS IN NORTH QUEENSLAND.

By H. W. Kerr.

The question of suitable new varieties for North Queensland conditions is one which is receiving close attention at the present time. Some of the requirements for these canes are—

1. Vigour and yielding capacity on the second-class lands, where Badila is not suitable.
2. Gum resistance, combined with vigour, to take the place of S.J.4 and Clark's Seedling in the Mulgrave quarantine area.
3. Varieties at least equal to the older canes in yielding capacity but which possess resistance to grubs and borers.

Some two years ago a number of trials were instituted in which the variety Q.2 was tested against standard canes, and it was found that this variety possessed certain virtues which made its planting worthwhile under specialised conditions: it appeared to exhibit tolerance to flooded conditions, while its high resistance to borer attack is a special feature. Q.2 was therefore approved for planting in all areas from Tully north.

Last year, three further "Q" seedlings—4, 10 and 12—were placed in farm yield trials, against standard varieties. Some of these trial areas have now been harvested and the results of the experiments with comments are presented below.

Brie Brie Estate, Mossman.

Soil Type.—Whitish clay loam. **Nature of Crop.**—Plant Cane.
Age of Crop.—14 months.

YIELDS.

Variety.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per cent.
Clark's Seedling	20·4	14·0
Q. 4	**24·5**	13·2
Q. 10	20·7	**14·7**
Q. 12	22·0	12·0

DISCUSSION.

Although the cane germinated well, and gave promise of a good crop, it was repeatedly checked by extremely dry spells, and it must be concluded that conditions were definitely adverse.

It is interesting to note that all varieties outyielded the standard. Variety Q.10 was also substantially better than Clark's Seedling in C.C.S.

Mrs. W. A. Johnston's Farm, Mango Park, Mossman.

Soil Type.—Forest loam. **Nature of Crop.**—Plant Cane.
Age of Crop.—14 months.

YIELDS.

Variety.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per cent.
S.J. 4	**14·3**	16·5
Q. 4	12·7	15·3
Q. 10	12·7	**17·0**
Q. 12	13·5	14·6

DISCUSSION.

A good strike was recorded, but the distinctly adverse conditions experienced by the crop severely checked its growth, and it did not profit from any beneficial rains.

S.J.4 slightly outyielded the new varieties, but Q.10 was decidedly superior in sugar content.

J. B. Anderson's Farm, Edmonton.

Soil Type.—Schist loam. **Nature of Crop.**—Second Ratoon.
Age of Crop.—11 months.

YIELDS.

Variety.	Plant Cane.		First Ratoon.		Second Ratoon.	
	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per cent.	Tons.	Per cent.	Tons.	Per cent.
Clark's Seedling	**41·4**	**13·85**	37·8	**16·8**	20·2	**16·0**
P.O.J. 2725	41·3	9·1	**41·4**	16·1	**21·7**	14·4

DISCUSSION.

This trial has never favoured P.O.J. 2725, in that the cane has been harvested early in each season; Clark's Seedling therefore exhibited a satisfactory C.C.S. value, but the Java variety was not given an opportunity of attaining maturity. P.O.J. 2725 has definitely shown its strong ratooning qualities; but its habit of early arrowing, followed by pithiness of the stalk, is a serious objection; the variety will therefore be of value in these parts only as an emergency cane, due to its virtue of high resistance to gumming disease.

J. McKenzie's Farm, Aloomba.

Soil Type.—Schist loam. **Nature of Crop.**—Plant Cane.
Age of Crop.—16 months.

YIELDS.

Variety.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per cent.
S.J. 4	24·9	16·2
Q. 4	**27·2**	14·2
Q. 10	21·7	**16·8**
Q. 12	24·6	15·2

DISCUSSION.

Due to dry conditions at planting time, the germination was only moderate, but the supplies assured a good stand. However, a most unfavourable growing season was responsible for the relatively poor crop.

Variety Q.4 gave the highest yield, but Q.10 lead the way for C.C.S. Variety Q.12 exhibited practically the same yielding capacity as the standard, S.J.4.

R. P. Matthews' Farm, Pawngilly, Babinda.

Soil Type.—Alluvial loam. **Nature of Crop.**—First Ratoon.
Age of Crop.—13 months.

YIELDS.

Variety.	Plant Cane.		First Ratoons.	
	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per cent.	Tons.	Per cent.
Clark's Seedling	**34·2**	**14·8**	**24·5**	**14·4**
Q. 10	28·3	14·3	22·3	14·3

DISCUSSION.

In the ratoons, Q.10 germinated well and quickly, and actually stooled better than Clark's Seedling. There was much less difference between the ratoon yields of the two varieties than was recorded for the plant crop, while the C.C.S. values were practically identical. The trial was harvested early in July, when the cane was scarcely mature.

Messrs. Gadaloff Bros.' Farm, Aloomba.

Soil Type.—Old alluvial loam. **Nature of Crop.**—Plant Cane.
Age of Crop.—17 months.

YIELDS.

Variety.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per cent.
Badila	20·3	17·0
Korpi	21·6	17·5
P.O.J. 2878	28·5	16·0
P.O.J. 2725	32·5	14·6

DISCUSSION.

Badila and P.O.J. 2878 germinated poorly and the supplies did not do well owing to dry conditions. Korpi and P.O.J. 2725 struck quickly and well. P.O.J. 2725 far outyielded the other varieties, but all were affected by the abnormally dry growing conditions. However, this cane arrowed early and completely, and its adhering trash was an objectionable feature. It was also low in sugar content, as compared with Badila and Korpi.

It must therefore be concluded that the Java "Wonder" cane (P.O.J. 2878) gave the best all-round performance—a good tonnage with a favourable C.C.S. In view of its resistance to gumming disease it should prove a useful variety in these parts, if only as a stop-gap.

Messrs. Suner & Sons' Farm, South Johnstone.

Soil Type.—Red volcanic loam. **Nature of Crop.**—Plant Cane.
Age of Crop.—14 months.

YIELDS.

Variety.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per cent.
Badila	31·0	12·7
Q. 4	36·1	8·3
Q. 10	37·6	11.7
Q. 12	30·8	8·6

DISCUSSION.

The cane germinated well, and made good early growth. The crop was so well advanced that in April, Q.12 was badly lodged, while Q.4 had also fallen to some extent.

The crop was harvested in late June, when all varieties were obviously immature. Q.10 gave the highest yield of cane per acre, outyielding the standard, Badila, by over 6 tons. Badila gave the highest C.C.S. Value.

R. G. Owen Jones' Farm, Japoon, South Johnstone.

Soil Type.—Alluvial loam. **Nature of Crop.**—Plant Cane.
Age of Crop.—12 months.

YIELDS.

Variety.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per cent.
Badila	40·3	10·1
Q. 4	44·4	7·6
Q. 10	40·3	**11·5**
Q. 12	**45·3**	10.1

DISCUSSION.

The trial was located on a block which was formerly an orchard, and due to the generally favourable growing conditions experienced, a heavy crop resulted. In March, varieties Q.4 and Q.12 were lodged, while Q.10 had gone down in parts. When harvested, considerable borer damage was observed in Q.4, Q. 10 and Badila, and the cane was partially rotted on the heaviest yielding plots.

Variety Q.12 gave the highest yield of cane per acre, while Q.10 was definitely richest in sugar, though the canes were harvested in July.

G. F. Hudson's Farm, Mourilyan.

Soil Type.—Sandy loam. **Nature of Crop.**—Plant Cane.
Age of Crop.—12 months.

YIELDS.

Variety.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per cent.
Clark's Seedling	32·1	**14·8**
Q. 4	**34·2**	11·5
Q. 10	32·2	14·4
Q. 12	29·8	13·6

DISCUSSION.

Favourable early conditions assured the establishment of the crop, but droughty conditions during late spring checked growth. A fair growing season until the crop was harvested resulted in a very fair yield for land of this type. Q.4 gave the heaviest cane tonnage per acre, but the standard, Clark's Seedling, yielded the highest C.C.S. Q.10 exhibited favourable characteristics, and in yield and C.C.S. content behaved similarly to the standard. Doubtless this variety would have attained a higher degree of sweetness at maturity.

J. H. McCutcheon's Farm, Liverpool Creek, Mourilyan.

Soil Type.—Alluvial loam. **Nature of Crop.**—Plant Cane.

DISCUSSION.

This trial consisted of two small plots, one each of Q. 2 and Q. 10, in which comparative observations were made in respect of yield, c.c.s. and borer infestation.

The plots were too small to be regarded as satisfactory for yield purposes: the Q.2 produced about 45 tons of cane per acre and out-yielded the Q. 10 by several tons. Of 100 selected sticks of each variety, 20 of Q. 2 and 67 of Q.10 had been attacked by borer. In this area, borer infestation is particularly bad, and Badila is always seriously damaged. Most of the infestation had occurred in the bottoms of the sticks, and very few living borers or larvæ were present.

The comparative c.c.s. values when the crop was harvested were—

	Per cent.
Q. 2	14·6
Q. 10	**16·3**

Q. 10 was therefore much superior to Q. 2 in respect of sugar content.

GENERAL DISCUSSION AND CONCLUSIONS.

In all, the results of nine full-scale field trials are reported above. The trials as a whole are interesting, in that they show that new varieties are being obtained which outyield the older canes, in many instances. This is true also where the standard cane was the reputedly vigorous grower, S.J. 4. In addition, certain of them carry a favourable sugar content, which is most desirable; and it is felt that, although none of them is proposed as an alternative cane to Badila, on first-class lands, doubtless they may prove superior on inferior soil types.

On the basis of the first series of results available, the following tentative conclusions are offered:—

1. Variety Q. 10 was, on the average, less than three-quarters of a ton per acre inferior to the standard canes, which included Clark's Seedling, S.J. 4, and Badila. In sugar content it averaged about 0·4 unit above the standard variety of the trial. The disparity would doubtless have been greater, if the cane had been harvested when Q.10 was mature. Having regard for its gumming and borer resistance, this variety gives promise of becoming a useful commercial cane.
2. Variety Q. 4 will be discarded because of its brittle nature and poor sugar content.
3. Variety Q. 12 will also be deleted, owing to its poor stooling qualities and lodging habit, as well as for its unfavourable C.C.S.
4. Of the Javan canes, P.O.J. 2725 has performed generally unfavourably; it always arrows early, is usually associated with clinging trash, and its sugar content is not satisfactory. P.O.J. 2878 has behaved much better, and it is suggested that this cane be given wider scope on the poorer lands of the Mulgrave quarantine area, due to its high degree of resistance to gumming disease. In the Mossman area it has increased rapidly in favour, and has displaced a number of inferior old-time varieties.

Introduction of Cane Varieties from Overseas.

By Arthur F. Bell.

IN common with most other crops there has been a great deal of interchange of varieties of sugar-cane between the different cane sugar producing countries of the world. At first, of course, this was entirely an unco-ordinated exchange of varieties as between growers in different countries. However, as time went by, it became apparent that this uncontrolled interchange of varieties also meant interchanging diseases, and of later years the responsibility for importing new varieties has been vested in the various Experiment Stations, which have facilities for guarding against the

consequent importation of diseases. Those countries which went somewhat slowly in the matter of variety introduction in the early days, and which early adopted a system of strictly controlled introductions, now have their reward in a comparative freedom from serious diseases of sugar-cane.

Unfortunately, Queensland was very late in regulating variety importation with the result that we now have the world's richest collection of cane diseases. In this case, however, such control is much better late than never. There are still some diseases which do not exist in Queensland and also certain strains of some of the diseases we already have. Therefore it is very desirable that all reasonable precautions should continue to be taken when importing new varieties, and this can best be done under the aegis of the Bureau of Sugar Experiment Stations. The Bureau maintains an insect-proof quarantine house in Brisbane; all varieties received from abroad are fumigated on arrival and then grown in the quarantine house, under constant supervision, for a year. By the adoption of these precautions it is highly unlikely that any disease would be spread into cane-growing areas.

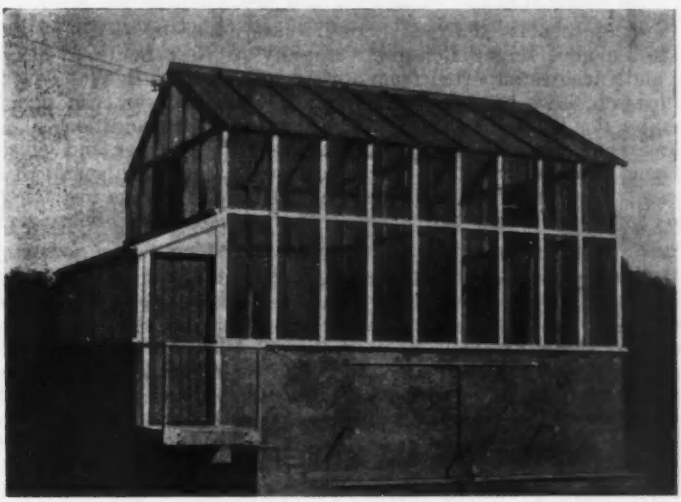

Fig. 20.—Showing the quarantine glasshouse in which all newly-received canes are grown for a year.

Incidentally, it might be advantageously pointed out that this quarantine house has well justified its existence. In 1936 Fiji disease was detected in two varieties which had been imported from New South Wales. If we had had no quarantine facilities and these cuttings had been sent to one of our field stations for propagation, then Fiji disease might have been introduced into Central or Northern Queensland. Naturally all varieties growing in the quarantine house at that time had to be condemned; the apparently healthy canes were planted again and grown under observation for a further year before being distributed. This occurrence also explains why some varieties—Q. 2 for example—have been a year late in reaching certain of the districts in Queensland.

For some reason, obscure to us, there exists in some quarters a belief that since the re-organisation of the Bureau, ten years ago, the importation of varieties from abroad has been greatly reduced and that the present administration does not favour such importations. We trust that this belief will be exploded by a comparison of the number of varieties imported direct by the Bureau during the ten years 1928-1938 with the previous ten-year period of 1918-1928 (June to June in each case) :—

Country of Origin.	Varieties Imported, 1918-1928.	Varieties Imported, 1928-1938.
Hawaii	6	68
Java	8	13
Mauritius	13	0
India	6	12
United States	0	9
West Indies	3	2
New Guinea	1	1
Philippine Islands	4	0
Totals	41	105

During the last ten-year period some dozens of seedlings raised by the Colonial Sugar Refining Company in New South Wales and Fiji, and varieties imported from abroad into New South Wales by that organisation, have been introduced into Queensland for trial purposes either by the Bureau or by the company itself. In addition, in 1928 an American Sugar Cane Expedition visited New Guinea and collected over one hundred varieties which were placed at the disposal of the Bureau. In actual fact therefore it will be seen that the last ten-year period has been a very active period in the matter of foreign variety introduction.

It is true that the existence of these varieties has not been brought so prominently before the public in later years as previously. In former years newly imported varieties were often distributed for farm trial as soon as sufficient stocks were available; they were not tested for disease resistance and were allowed to find their own level by trial and error test. Nowadays, however, we have both the staff and the facilities for carrying out disease resistance trials on an adequate scale, and new varieties must satisfy the disease resistance requirements of a district before they are placed in yield trials in that district. Most other sugar-cane producing countries have very few major diseases, and the varieties we obtain from them have naturally not been tried out against more than one or two of our diseases. Consequently, when we subject them to disease-resistance trials the majority are found wanting and are quietly discarded; naturally, then, the general public hears nothing of them.

In Hawaii, for example, the only major diseases common to our two countries, and for which resistance trials are carried out, are leaf-scald and chlorotic streak diseases. When we subject their varieties to test we find the vast majority of them susceptible to gumming, downy mildew, or Fiji disease, or all three of them, and very few have ever reached farm yield trials. This system is obviously a much better one than that of planting the varieties out to considerable areas and then finding that they are highly susceptible to one of the particular diseases present in that district.

Actually, the number of countries from which we can import varieties is very restricted since a number of the cane-producing countries carry out little or no cane breeding. The important sugar-cane country of Cuba, for example, has never greatly interested itself in cane breeding, while some countries, such as South Africa, are situated too far from the tropics to permit of cross pollination of cane varieties. Java, once a valuable souce of new canes, now prohibits the export of canes, therefore its newer seedlings are not available to us.

A discussion of the question of variety importation from overseas must necessarily include reference to the neighbouring island of New Guinea. Owing to the remarkable success of Badila in this country there is quite naturally a feeling on the part of farmers generally that we should continue to seek new varieties in that country. With that viewpoint we agree to a certain extent, but there are several factors to be considered. In the last fifty years several hundred varieties (probably many of them duplicated) have been brought from New Guinea to Australia, but with the exception of Badila and Korpi, there is not a single one of all these varieties which amounts to 1 per cent. of our crop (Korpi constitutes about 1·25 per cent.). Thus it would seem that the importation of Badila has been a very large slice of luck and, had that variety not been introduced, New Guinea varieties would have been regarded as very second rate.

New Guinea is one of the original homes of sugar-cane, and we also know it to be the original home of a number of the important sugar-cane diseases. In those places where the cane and certain diseases have existed together for centuries, we might expect that the cane must have acquired a certain amount of resistance in order to survive. It does not appear to us that New Guinea is likely to prove a promising hunting ground for new commercial varieties but it does attract us from the standpoint of a suitable place from which to obtain lines from which to breed. It is logical to assume, for example, that the place to look for canes for use in breeding for Fiji disease resistance is a section of New Guinea where Fiji disease is found. Unfortunately, it would be necessary to send an expedition to New Guinea to observe the diseases and collect such canes, since the organisation of that country is not such as to obtain a satisfactory collection otherwise. Should such an expedition ever visit New Guinea it would also be of great interest for it to examine the type of cane which was found by the late J. G. Hides, and which was growing at an elevation of over 6,000 feet.

We trust that in the foregoing discussion sufficient has been said to dispel any false ideas that the importation of varieties from abroad has been curtailed, or that there is an intention of curtailing it. On the other hand, it is wise not to expect too much of imported varieties. Yields are increasing in most sugar-cane countries, due in part to the development of varieties which suit local conditions better than the varieties they displace. It therefore becomes more and more the case that an outstanding variety in any country is outstanding because it dovetails closely with the particular requirements of that country, and hence is not particularly likely to be a pronounced success in any other country. It is interesting to note that Badila, the outstanding cane of Queensland and Fiji, is scarcely grown elsewhere. H. 109, the "wonder" cane of Hawaii, is seldom worth a second look in other countries; P.O.J. 2878 has not found outstanding favour outside Java (although of great

value in parts of Southern Queensland and New South Wales). B.H. 10/12 and S.C. 12/4, the leading canes of the West Indies, are a failure elsewhere, and so on. It seems to be very much a matter of hit and miss, and it would appear that the needs of a country are best served by developing its own cane-breeding services to the utmost. To this end the Bureau is now raising seedlings at its three field stations, and the resultant seedlings, after full test, are commencing to reach commercial scale plantings.

At the present time one of our officers, Mr. N. J. King, is visiting Hawaii and the United States, and he has been instructed to make enquiries regarding varieties suitable for importation into Queensland. It will be readily appreciated that the man on the spot has a much better basis for judging the possibilities of a variety than is obtainable from reading reports, and we look forward with interest to receiving his selections.

Annual Report of the Director for the Year ended 30th June, 1938*.

STATISTICS OF THE 1937 CROP.

The yield of raw sugar in Queensland for the 1937 crop was 763,325 tons of 94 n.t. This was an all-time record, exceeding that of the previous record of 1936 by some 18,677 tons.

The area harvested was 249,683 acres, which represents an increase of 4,531 acres over the area harvested in 1936.

The yield per acre was 20·6 tons of cane and 3·06 tons of sugar. The latter is a record figure, as is also the tons of cane required to make a ton of 94 n.t. sugar—6·73. The average area harvested per planter was 30 acres.

Over 440,000 tons of sugar were exported; this represents about 30,000 tons in excess of the annual Australian export quota. No. 1 pool sugar averaged £17 11s. per ton, while the value of *all* sugar (including excess) was £15 6s. 5d. This is the second lowest average value recorded since 1914. The total value of the crop was £11,686,640—an all-time record.

MOLASSES PRODUCTION.

During 1937, some 20½ million gallons of molasses were disposed of by the raw sugar mills; in view of the growing interest in the utilization of this product for the production of alcohol, the accompanying graph,

* Each year the Director is required to prepare for Parliament a Report of the work of the Sugar Experiment Stations. It is now proposed to issue annually a summary of this report, indicating the chief features of the work, in the October Bulletin.

Fig. 21 is presented. It will be observed that the quantity absorbed by distilleries (7 million gallons) is the highest used for this purpose: an increased quantity was employed as manure (3,360,000 gallons), while 3,910,000 gallons were disposed of as stock feed. The amount required by the mills as fuel was 5½ million gallons. The amount run to waste was negligible, being less than 500,000 gallons, or 2½ per cent. of the total production.

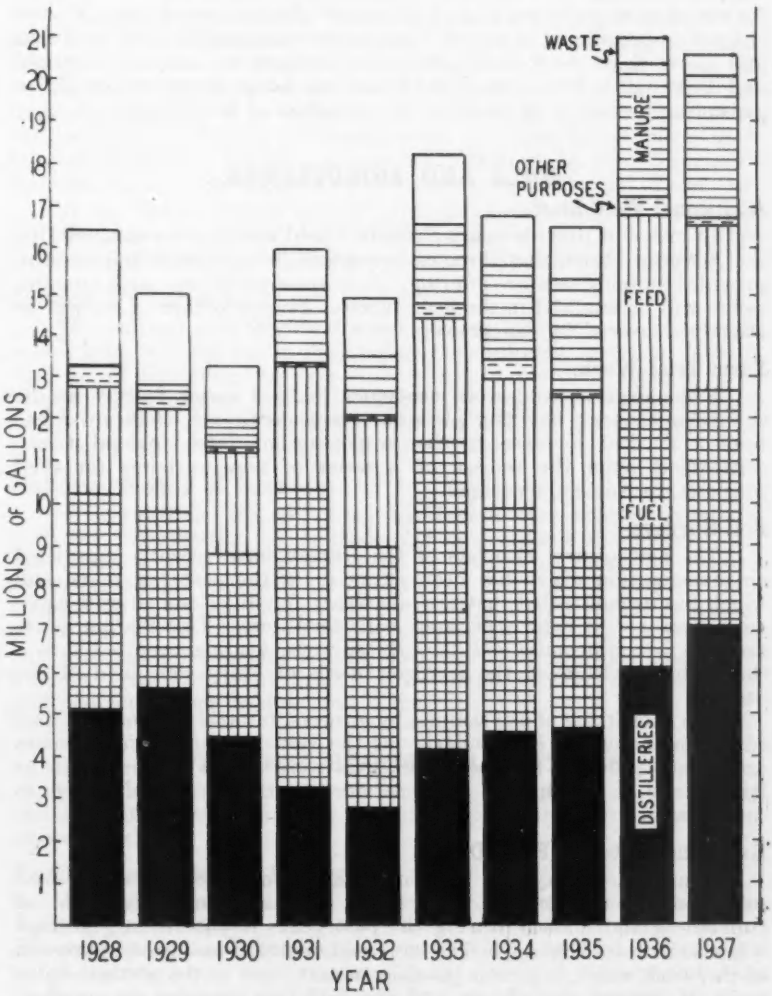

Fig. 21.—Illustrating the trends in molasses utilization over the past ten years. The amount now run to waste is insignificant.

ADVISORY BOARD.

The Advisory Board held two meetings during the year. A new Board was constituted in March, and is now composed of Messrs. N. H. Wellard (Mossman) and C. W. Thiele (Bundaberg), representatives of canegrowers; Messrs. J. Smith (Mackay) and A. V. Thorp (Nambour), representatives of millers; with the Government nominees, the Hon. F. W. Bulcock (Minister for Agriculture), as Chairman, and the Director (Dr. H. W. Kerr).

During the year the Board gave close attention to a number of matters affecting the work of the Bureau, and notably in devising plans for the more effective working of this phase of sugar production. Disease control, improvement of the field service, the utilization of by-products, and the work of the Pests Boards, were amongst the subjects discussed and dealt with. The work of the Board has assisted very materially in promoting increased efficiency in the operation of the Bureau.

SOILS AND AGRICULTURE.

Additional Field Staff.

In order to provide a more effective field service, it was agreed by the Advisory Board that three cadets should be appointed and trained, provided suitable men are offering. It is anticipated that such appointments will be finalised in the near future. Doubtless this action will be warmly welcomed by canegrowers.

Farm Trial Work.

Farm experimental work continues to be a major feature of the extension service. Fertility plots have been continued, while there has been a marked increase in the proportion of farm varietal trials, consequent upon the release of a series of new varieties for trial purposes, in North Queensland.

Soil Surveys.

The agricultural chemists of the Bureau have recently completed an investigation which has been pursued for the past ten years, and which has demonstrated that the laboratory fertility tests on soils agree very closely with field experience with fertilizers. This finding paves the way for systematic soil fertility surveys, leading eventually to a thorough knowledge of the fertilizer needs of every cane field of the State.

The submitting of soil samples by growers, for analysis and fertilizer advice, is increasing in popularity as the value of this advice becomes appreciated; during the year 528 soils were tested in the Brisbane laboratories of the Bureau. This service is provided free of charge to canegrowers.

Experiment Station Field Days.

Annual field days at the Sugar Experiment Stations are well supported by canegrowers. Functions of this nature were held at Bundaberg and Mackay during the past year; in the future, Meringa will also have its field day. The increased standard and greater breadth of the work which it is now possible to carry out at the stations holds much of interest to farmers, and the field day provides an excellent opportunity for the officers of the Bureau to meet growers, and demonstrate their work.

Legume and Fodder Crops.

Considerable work has been done in an attempt to provide for canegrowers, more suitable legumes than are at present available, and fodder grasses which may prove useful for paddocks in which stock are grazed, or which could be harvested for fodder or hay-making purposes. Doubtless canegrowers could save considerable expenditure on horse feed if they would devote closer attention to the production of crops for the purpose: even where the use of a supplementary ration of concentrated protein meal were necessary, the utilization of molasses as a source of energy food would reduce feeding costs very substantially.

Of the legumes under tests, clovers, lespedezas, and soybeans were found to be generally unsuitable, but very encouraging results have been recorded with two species of Crotalaria. Sunn hemp (*C. juncea*) is a vigorous grower, which gave good yields at Meringa and Bundaberg: but it is probably not so suitable as *C. goreensis*, which will be known in future, as Gambia pea. For long fallow purposes it appears to be very useful, and further plantings on the Experiment Stations and on selected farms will be made towards the end of the year.

Of the fodder grasses tested, white panicum, *Panicum coloratum*, and fine-stemmed Guinea grass showed promise, and will be further experimented with; white panicum was specially favoured by stock.

Cultures for Legumes.

The culturing of highly-efficient strains of root nodule bacteria is now being carried out in the Brisbane laboratories, and cane farmers desirous of obtaining cultures with which to inoculate legume seeds prior to planting were invited to apply for them. This service is being keenly availed of, and doubtless benefits will be derived from the practice as has been the case in overseas countries.

Maturity Testing of Cane.

Some years ago the officers of the Bureau were actively associated with the investigation of methods for determining the maturity of cane crops, so that the farmer would be assured of maximum returns for his product. Unfortunately, growers have not responded in a manner which would demonstrate that they fully appreciate the value of such a service. The experiment stations are not able to cope with any systematic campaign of this character, but they are willing to conduct tests for those farmers who submit regular samples taken systematically from their several fields.

EXPERIMENT STATION PLOT TRIALS.

Several interesting trials were harvested during 1937 on the Mackay and Bundaberg Stations. The main features of these experiments are recorded below.

Fertility Trial, Mackay Station.

Although the plant crop yields showed little benefit from the fertilizers applied, the ratoons exhibited unmistakable gains for top dressings of sulphate of ammonia. On all old lands the humus supply is greatly depleted, and almost without exception, substantial crop increases are regularly obtained from the use of this material. The use of the correct fertilizer in adequate amounts is one of the first essentials in the production of successful ratoons under these conditions.

The actual yields for the first ratoon crop of this trial were—

"No manure" plots	.. ..	11·4 tons per acre
Fully fertilized plots	.. ..	19·5 tons per acre
Gain from manure	..	8·1 tons per acre

Irrigation and Nitrogen Trial, Bundaberg.

The benefits of irrigation on the red volcanic soils of the Bundaberg area are demonstrated by the results of this trial to date. The plant crop (varieties P.O.J. 2725 and P.O.J. 2878) averaged 58 tons of cane per acre (despite early frost damage), while the first ratoon yield was 42 tons per acre, although the cane received water only in alternate interspaces for the first six months of its growth, and none thereafter.

Despite these heavy crops, no outstanding gains were recorded for sulphate of ammonia, which shows quite clearly that these soils, when moderately and consistently manured, are capable of heavy yields if given the necessary moisture supply.

Of the two varieties, P.O.J. 2725 was much superior to P.O.J. 2878 under these conditions.

The averages were—

Variety.	Plant Crop.	First Ratoons.
	Tons.	Tons.
P.O.J. 2725	63·0	46·6
P.O.J. 2878	50·5	35·6

Trash Trial, Bundaberg.

An experimental block was selected in 1933, and subdivided into four plots, on two of which all trash and tops were to be conserved and ploughed under, while in the remaining two, all crop residues were to be burned annually.

For the first two cane crops, no benefits from the treatment were detected, but it is of interest to note that in 1937, the plant cane from the trash plots was slightly heavier than that for the "no trash" plots. It will be interesting to observe whether this advantage will be maintained.

This experiment will be continued for a number of years to demonstrate the cumulative effects of the treatment.

Potash Trial, Bundaberg.

It is recognised that crops on the red volcanic loam frequently show response to application of potash, particularly where this plantfood has not been applied consistently. On the other hand, regular applications of even moderate amounts of this material soon eliminate such deficiencies. It was therefore decided to institute a "permanent" potash trial, on some plots of which dressings of different magnitude would be applied, while on others potash would be withheld.

The first plant crop from the trial was seriously affected by the droughty conditions, and no significant effects were recorded for any of the treatments.

Cultivation Trial, Bundaberg.

It has been reported on frequent occasions that cultivation appears to be without influence on crop yield on the red volcanic soil, except in-so-far as it controls weeds. A trial was instituted in 1934, which combined deep grubbing (subsoiling) with surface cultivation. Three crops have now been harvested, and in no instance could any benefits from the several operations be detected. Doubtless old-established opinions in this regard must not be accepted without careful examination, in the light of specific soil types and local conditions.

Varietal Trial, Mackay.

The first series of three finally selected seedlings, raised on the Mackay Station since this project was initiated, have been under yield trial for the past three years. The results for the plant and first ratoon crop are now available:—

YIELDS.—Plant and First Ratoon Crops.

Variety.	Plant Crop.		First Ratoons.	
	Cane per Acre.	C.C.S in Cane.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per cent.	Tons.	Per cent.
Q. 813	32·0	16·6	30·4	16·6
C. 57	30·6	**17·6**	34·3	**18·4**
C. 83	**40·0**	16·4	**42·7**	16·5
C. 85	32·8	16·8	37·9	16·4

It will be noted that C. 83 has far outyielded Q. 813 in both years, while the C.C.S. was also satisfactory. Unfortunately both C. 83 and C. 85 (which are seedlings of P.O.J. 2878) are too highly susceptible to downy mildew disease to make further plantings desirable. The variety C. 57 (now called **Q. 20**) is at least equal to Q. 813, but shows in addition a particularly high C.C.S. This variety is now in farm propagation plots, and it is anticipated that it may be released for general planting in 1939.

Varietal Trial, Bundaberg.

A varietal trial which included Co. 290, P.O.J. 234, P.O.J. 2725, and P.O.J. 2878 has been in progress at Bundaberg for three years. The plant and first ratoon crops both showed the outstanding value of P.O.J. 2725 in yield and C.C.S. Even during the droughty conditions of 1937, it yielded a ratoon crop of almost 20 tons per acre.

Varietal Trial, Bundaberg.

An experimental block, the results from which should prove of interest to Southern Queensland growers, was harvested as a plant crop in 1937. It contained all the gum-resistant P.O.J. varieties and Co. 290; the year

was, however, far from favourable, due to the light rainfall, so that the results mainly reflect drought resistance. The heaviest tonnage was given by P.O.J. 2875 (22 tons per acre), but P.O.J. 2883 and P.O.J. 2878 were very little inferior. Co. 290 suffered severely from the dry conditions. In C.C.S content, P.O.J. 2883 was the best of all the high yielding canes, although it was inferior to P.O.J. 2725. The ratoons from this field, to be harvested this season, should be particularly interesting.

Varietal Trial, with Single *v.* Double Planting, Bundaberg.

In this trial, the varieties were Co. 290 and P.O.J. 2878: plots of "single" and "double" plantings were also provided. There was no great difference between the yields of the two varieties, but P.O.J. 2878 gave the higher C.C.S. The results for double sett planting, as against single setts in the furrow, were a net gain for the former of 3·7 tons of cane per acre, from the plant and first ratoon crops combined. This emphasises the desirability of the practice with canes which are liable to give a poor germination.

Rotational Grazing Block, Mackay Station.

This block of rather inferior soil is some 16 acres in area, and it has been subdivided into eight plots, each of 2 acres. These plots will be worked in an eight-year rotation, as follows:—(1) Plant cane, (2) first ratoon, (3) grass, (4) grass, (5) grass, (6) grass, (7) grass, (8) grass. The plant cane will be preceded by a green manure crop, while a similar crop will also be planted and ploughed under before seeding to grass after the ratoon crop. In this way an attempt will be made to determine the value of such a programme in restoring the fertility of old soils. All trash and tops will be conserved, also, and returned to the soil.

While the land is in pasture it will be grazed by sheep. A flock of Merino-Corriedale ewes has been purchased, and these are mated with a Romney Marsh ram for the production of cross-bred lambs. The ewes from this mating will be retained for further cross-breeding purposes.

The results of the experiment to date are very interesting. The plant crop from Plot No. 1 yielded 26 tons of cane per acre in 1937: Plot No. 2 was planted in the spring of 1937, and Plot No. 3 in the autumn of 1938. The sheep yielded wool to an average value of 5s. 2d. per head; as there are the equivalent of 37 sheep grazing an 8-acre block throughout the entire year, the carrying capacity of the land can be gauged. The chief pasture crop to date has been Panicum muticum.

During the drier months of the year, before and after the lambing season, the ewes were given the following supplementary ration per week:—

1 oz. sterilized bone meal.
12 oz. linseed (*later*, peanut) meal.
32 oz. molasses.

The first wether lambs to be slaughtered were found to be of good quality, and it may be concluded that the experiment has established the possibilities of fat lamb raising on this area of the tropical coast.

CANE BREEDING.

General Methods.

The germination, propagation and testing of new cane seedling varieties is carried out at the three field stations of the Bureau, viz.—Meringa, Mackay, and Bundaberg. As the cane flower sets seed only within the wet tropical belt of Queensland, all cross-pollination has to be carried out at the northern station; the ripened seed is then sent to Mackay and Bundaberg in sealed containers for germination. These three stations represent the wet tropical, dry tropical, and sub-tropical regions of the Queensland sugar belt, and crosses are planned accordingly and the selection of seedlings is made under each set of conditions. It is obvious that it would be useless trying to raise all seedlings at Meringa and to try and select canes for Bundaberg under these conditions. On the other hand any promising seedlings raised at any one station are sent to Brisbane, grown in quarantine, and then sent to the other districts for field testing. Consequently the results obtained at any one station are eventually made available to all districts.

Our present programme provides for the raising of about 10,000 seedlings per annum at Meringa and 5,000-6,000 at Mackay and Bundaberg. A certain number of crosses are always made with the object of providing canes for the selection of parents for future crossing, and these are made at Meringa. The particular crosses forwarded to each Station depend on the requirements of the district and the known behaviour of the progeny of a particular cross. For example, it is known that P.O.J. 2878 when used as a parent confers high resistance to gumming disease on a very high proportion of its progeny; P.O.J. 2878 is therefore used to a considerable extent in the crosses intended for Southern Queensland.

Trends in Selection.

The outstanding requirements of new canes in the northern and central districts at the present time are varieties which will have stronger rooting systems which will enable them to resist grub attack better, and harder rinds which will give greater resistance to borer attack. As a result of these requirements we are compelled to work towards a somewhat increased fibre content of cane. It is likely therefore that the canes of the future will have a somewhat higher fibre than the canes they replace.

Early maturity is continually sought, but is a most difficult character to couple with reasonable vigour. We have obtained some cane-sorghum hybrids, and are experimenting in the hope of developing early maturing varieties from these. Disease resistance trials are continuously carried out, and very many seedlings are discarded on account of their failure to possess a sufficiently high standard of disease resistance.

1938 Cross Pollination Season.

It is unusual to have two very bad arrowing years in succession, but the extraordinarily dry autumn and early winter conditions of the past two years greatly depressed arrowing in the Cairns district. This year, owing to little or no arrowing in such varieties as Oramboo,

Korpi, 1900 Seedling, Q. 813, E.K. 28, S.C. 12/4, D. 1135, P.O.J. 2878 and Badila, we were unable to make many of the matings which were planned. Nevertheless over sixty different crosses were completed and have provided seed from a wide and interesting range of parent canes. A considerable amount of this seed is the product of cane × ½ sorghum crosses, and the resultant seedlings should therefore contain one-fourth sorghum "blood." As may be imagined their growth will be watched with great interest. We also succeeded in obtaining a good lot of seed from crosses with P.O.J. 213; this variety is often very difficult to cross, but its high Fiji disease resistance makes it attractive for trial.

"Original" and "Selected" Seedlings.

Every seedling produced is a new and distinct variety, so that when we speak of raising 20,000 seedlings we actually mean the production of 20,000 new varieties. Although the seedlings produced from any one cross may often be very similar in type the chances of any two being identical are but one in many millions.

A stool of cane which is produced from the germination of a tiny seed is known as an *original* seedling. When these stools are about a year old they are carefully inspected, and the most promising are selected for further planting—the rest are rejected and milled. Those seedlings which are retained for further trial are known as *selected* seedlings. The practice in Queensland is to grow the seedlings on the stations for about 4-5 years—testing, re-selecting, and discarding—before the final selections are sent out for farm trial.

Varieties Under Trial at Experiment Stations.

There are, of course, many hundreds of selected seedlings under trial at the three stations where they are tested for vigour, type of growth, germination, coverage, sugar content, time of maturity, ratooning, fibre content, hardness of rind, resistance to disease, and so on. However, these varieties do not hold much direct interest for the cane farmer, whose chief concern is naturally with those survivors which ultimately go out on to the farms for field trial.

The most interesting seedling from last year's batch is one obtained from crossing a cane-sorghum hybrid (Co. 515) with P.O.J. 2940. The small planting of this newly-introduced hybrid gave rise to a couple of arrows very early in the season, and the only material available for crossing with it was an early arrow of P.O.J. 2940. One lone seedling resulted from the cross, but it has proved quite vigorous, and is, we hope, a sample of what might be expected from this cross in the future; as noted elsewhere we have this year a fairly large quantity of seed from this cane-sorghum hybrid crossed back on to cane of several varieties.

Q. Seedlings.

Seedlings which go out into farm trials are given a "Q" number to distinguish them permanently. Since the adoption of this system of naming, four years ago, some twenty-seven of the Q. series have been set out in farm trials. One, Q. 2, has been approved for commercial

planting, some have been discarded, two will probably be approved for planting next year, while others are still in the early stages of farm testing. For the information of farmers we append a brief note on such of these twenty-seven canes as are being propagated for commercial planting or are still under field trial.

Q. 2.

This variety was approved for commercial planting in the northern district in 1937, and a considerable tonnage will be harvested this year. This is not a general purpose cane, but should prove useful in special locations; it has a very erect habit, is free-trashing, and has high resistance to top rot, borer attack, and good resistance to flood damage, is a latish maturer with medium to good sugar content, and produces a good plant crop under conditions of adequate moisture. On the other hand it does not do well under dry conditions, is a slow ratooner, and should not be harvested before about mid-September.

Propagation plots of this variety have been established in Mackay and the Lower Burdekin, where it will be fully tested; it is too susceptible to gumming disease to be considered, at present, in the southern districts.

Q. 4 and Q. 12.

Q. 4 and Q. 12 were planted in a number of farm yield trials in North Queensland, but will be discarded on account of low sugar, brittle nature, and lodging under farm conditions in the case of Q. 4, and unsatisfactory stooling and sprawling habit in the case of Q. 12. The yield of cane in both instances was fairly good, but both are definitely inferior to Q. 10.

Q. 10.

Q. 10 has performed well during the past season when grown in competition with S.J. 4 and Clark's Seedling, and we hope that this variety, being resistant to gumming, will serve as a satisfactory substitute for S.J. 4 and Clark's Seedling in the Mulgrave area. Sugar content is good, and to date, strike and ratooning have been satisfactory. Propagation plots have been established in each of the northern mill areas, and the variety is at present growing in quarantine in Brisbane preparatory to transfer to other districts for trial.

Q. 10 is faily resistant to gumming and leaf-scald, and in the northern areas, is considerably more resistant to top rot and borer damage than is Badila.

Q. 13 and Q. 19.

These two varieties have been set out in farm yield trials in the northern areas this year, but little is known of their performance to date. Q. 13 has an excellent sugar content and appears to germinate well, but, unfortunately, recent indications are that it ratoons weakly.

Q. 21, Q. 26 and Q. 27.

These three vigorous canes have been planted in farm observation trials, and will be advanced to farm yield trials in 1939 if they continue to show promise. Maturity tests now being carried out indicate that they are rather low in sugar, and they may have to be discarded on this account.

Q. 20.

Q. 20 was bred at the Mackay Experiment Station, and some twenty-five propagation plots will have been set out on farms in the central district by the time this report appears in print. It is a medium cropper, giving a plant crop of similar tonnage to Q. 813, but ratoons considerably better than this variety; sugar content has been consistently high and maturity early to mid-season. A propagation plot of this variety has also been established in the Lower Burdekin district, and supplies will be transferred to the northern and southern areas next year.

Q. 22, Q. 23, Q. 24, Q. 25.

Of four seedlings tested at Bundaberg during the past season Q. 25 appears definitely the best yielding variety. Unfortunately it has exhibited susceptibility to Fiji disease and, in view of the Fiji and downy mildew disease situation in Southern Queensland, its further propagation has been postponed pending confirmatory disease resistance trials.

Varietal Statistics.

In Table I. are set out the percentages of the varieties crushed in each of the four major districts during the four years 1934-1937. It will be of interest to review this table again in three or four years time, when some of the new Q. series seedlings will have had time to become established, should they prove suitable to local conditions. It will be seen that over the four-year period the greatest changes have taken place in the southern district where the gumming disease resistant canes, P.O.J. 2878, P.O.J. 213, and Co. 290, are rapidly replacing Q. 813 and Uba and the susceptible 1900 Seedling, D. 1135 and Black Innes. The rise of the thin Indian cane Co. 290 has been especially rapid, increasing from less than 1 per cent. in 1935 to 15 per cent. in 1937; this variety may be grown to some extent in the Mackay district, but trials have shown that it is definitely unsuitable for more northern districts.

Origin of Varieties.

Most canegrowers will doubtless be interested to know the composition of the Queensland cane crop according to the country of origin of the varieties concerned, and we have accordingly worked out the following table for the 1937 crop:—

	Per cent.
New Guinea	43·5
Queensland	23·0
Java	14·5
Mauritius	11·0
West Indies	3·5
India	3·0
Fiji	1·5

It is satisfactory to note that approximately one-fourth of the crop is produced from seedling canes raised in this country, and that these seedlings, together with varieties obtained from New Guinea by Australian expeditions, constitute two-thirds of the crop.

Storage of Cane Seed.

Sugar cane produces a very delicate little seed which soon loses its power to germinate when stored in moist air or at ordinary temperatures. This season we constructed an electrically-heated drying-box which rapidly and efficiently dries the "fuzz," which can then be transferred to sealed containers; a little calcium chloride is placed in the containers to absorb any traces of free moisture which may be left. Experiments carried out with the assistance of the North Australian Brewery showed that the germination of such dried fuzz was very greatly improved if it was stored in a chilling room. Under these conditions samples of fuzz were stored for a period of ten months and then germinated as well as the day they were stored.

TABLE I.—DISTRICT CANE VARIETY CENSUS, 1934-37.

Varieties which have constituted one per cent., or more, of District Crops, Grouped according to Country of Origin. Returns recorded to the nearest one per cent.

District	North of Townsville.				Burdekin and Giru.				Central.				Southern.			
Variety.	1934.	1935.	1936.	1937.	1934.	1935.	1936.	1937.	1934.	1935.	1936.	1937.	1934.	1935.	1936.	1937.
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Badila (N.G. 15) ..	65	61	60	59	38	49	51	55	16	15	12	13	1	1	1	1
Korpi	1	..	..	1	5	5	6	6	..	..	..	..	3	1	1	2
Oramboo	..	..	..	..	1	1	1	..	..	..	1	1	4	4	4	4
Mahona (N.G. 22) ..	..	..	..	..	..	..	..	..	..	..	..	..	3	2	1	1
N.G. 16	..	..	..	..	..	..	..	..	..	..	..	..	1	1	1	..
Clark's Seedling (H.Q. 426)	7	7	8	8	13	9	9	8	11	10	9	9	..	..	..	..
H.Q. 409	12	14	12	13	..	..	..	..	..	..	..	..	..	..	..	..
H.Q. 285	..	..	..	..	..	..	..	..	..	..	..	..	5	4	3	3
Q. 813	3	2	3	2	..	..	..	..	1	..	1	1	10	10	8	6
Q. 1098	..	..	..	..	1	..	..	..	12	11	9	8	1	1	2	1
S.J. 4	3	7	6	7	..	..	1	2	..	..	..	..	..	..	..	..
S.J. 2	1	1	1	2	..	..	..	1	..	..	2	2	5	10	17	22
P.O.J. 2878	..	..	..	..	..	..	..	..	..	..	2	5	4	5	4	3
P.O.J. 2714	..	..	..	..	1	..	..	1	7	8	6	1	6	11	17	15
P.O.J. 213	..	..	..	..	..	..	..	..	2	2	2	..	1	1	3	4
P.O.J. 234	..	..	..	..	..	..	..	..	12	11	9	8	10	10	8	6
E.K. 28	..	..	..	..	23	18	23	22	33	38	46	45	1	1	2	1
M. 1900 Seedling ..	..	..	..	..	..	..	..	..	1	1	..	..	13	4	2	8
Black Innes (M. 189)	1	1	3	2	..	..	..	..	1	1	..	..	22	18	12	8
D. 1135	4	4	3	2	15	13	8	5	..	..	..	..	7	9	5	4
B. 208	..	..	..	..	..	..	..	..	..	..	..	..	5	5	3	2
Uba	..	..	..	..	..	..	..	..	..	..	..	..	..	..	5	15
Co. 210 and 213 ..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..
Co. 290	..	2	2	3	..	..	..	..	..	..	..	..	..	..	..	..
Pompey (TR. 428) ..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

CANE DISEASES.

Gumming Disease in Cane.

Gumming disease has become still more difficult to find in Southern Queensland, due to the rapid elimination of the old susceptible varieties and their replacement with the resistant varieties P.O.J. 2878, P.O.J. 213, Co. 290, and to a less extent, P.O.J. 234. It is expected that in about two years the disease will be virtually extinct in the Bundaberg-Isis district. In fact the only district where this disease is now causing appreciable losses is the Mulgrave area. Here the disease has continued to spread into the highly susceptible S.J. 4 and Clark's Seedling, and for the protection of adjoining districts it has been necessary to declare the whole Mulgrave area a quarantine area and to prohibit the growth of S.J. 4 or Clark's Seedling therein. As soon as these two varieties have been eliminated it is expected that Q. 2 may be grown with safety throughout the area, but its growth would be unsafe in the poorly drained areas so long as it might be exposed to heavily infected crops of S.J. 4 and Clark's Seedling. The new seedling Q. 10 is gumming disease resistant, and has performed well this year in competition with S.J. 4 and Clark's Seedling. Several other resistant seedlings raised by the Bureau and also some raised by the C.S.R. Company are now in yield trials in the gumming area.

Gumming Disease in Other Plants.

During the past three years we have conducted an investigation into the possibility of gumming disease being carried over in plants other than sugar cane. If other plants can carry the disease then it follows that it would be unwise to release any highly susceptible varieties for planting on an area where gumming disease has been present at one time or another. Upon inoculation the following plants were found to contract gumming disease:—A number of maize varieties including those most widely grown in Queensland, sweet and grain sorghums, Soudan grass, Guinea grass, bastard sorghum, Para grass, Elephant grass, and Johnson grass. Some of the sorghums, in particular, proved highly susceptible and oozed gum as freely as susceptible cane varieties. It seems likely then, that we have growing in and around our cane-fields a number of plants which can contract gumming disease, and our future policy must be influenced by this finding. It is of interest to note that in some of the above listed plants the symptoms of gumming disease are quite unlike those in cane.

Fiji Disease and P.O.J. Varieties.

As is well known by most canegrowers the higher numbered P.O.J. canes (P.O.J. 2714, 2725, 2875, 2878, 2883, 2940, &c.) all contain a certain amount of wild cane in their ancestry. This wild "blood" gives these canes their vigorous growth, strong rooting systems, strong ratooning and resistance to mosaic and gumming diseases. At the same time however, it confers high susceptibility to Fiji disease in the case of all the varieties mentioned; there is not much to choose between them and the only commercial variety which exhibits greater susceptibility is Uba.

Increased susceptibility to such insect-borne diseases expresses itself in an interesting way. Whereas a stool of a resistant variety may require to be fed upon by, say, eight or ten infective insects before it will contract the disease, susceptible varieties may require only one insect per stool. When these insects are blown out of a diseased field by a high wind it is obvious that many stools will receive one hopper whereas very few would receive, say, five or six. Herein lies the danger of a susceptible variety in that it can become diseased when fed upon by a single infective insect.

Fiji disease constitutes a very grave threat to the continued growth of P.O.J. 2725 and 2878; the seriousness of the situation cannot be over-emphasised and we cannot urge too strongly that *now* is the time to take action to save these varieties.

Fiji Disease in the Bundaberg-Isis District.

A small amount of Fiji disease has been present in the Bundaberg-Isis district for a number of years and had persisted on irrigated lands particularly. Several small outbreaks were found by Bureau officers and cleaned up and little damage was caused in the old varieties. With the planting up of P.O.J. 2878 however, the picture begins to tell a different story. The disease spreads into this very susceptible variety with great readiness and strenuous efforts will be necessary if this remarkable cane is to be saved for cultivation. During the year new outbreaks were discovered on the Woongarra, Paddy's Island and the Elliott, and as far as is known the disease is now present on three plantations and about thirty-five farms in Bundaberg and about twenty farms in the Isis.

In an effort to clean up this disease a number of disease eradication orders are being issued and it is hoped that there will be no trouble in enforcing these since the steps taken are all for the common good. The District Executives have also earnestly co-operated by employing gangs to inspect cane and dig out diseased stools.

1938 Season has Favoured Spread of Downy Mildew and Fiji Diseases.

Although caused by widely different agents and spread in entirely different ways downy mildew and Fiji diseases have a good deal in common. Actually Fiji disease is caused by a virus which is spread from plant to plant by the sugar-cane leaf hopper while downy mildew is caused by a fungus, the spores or "seeds" of which blow from plant to plant. On the other hand both are spread mainly during the warm moist months of summer and early autumn; both spread very little during the normal dry months of winter and early spring; and the symptoms of both may remain invisible for long periods after infection.

The long protracted late rainy season coupled with the late and mild winter in the Southern areas provided conditions which were favourable to the spread of both these diseases for an unusually long period. Indeed many cane crops carried very heavy leaf hopper infestation all through the winter in locations where normally it would have been very hard to find any hoppers at all at the end of June. Owing to the masking of symptoms of both diseases for long periods late infection may not show up until about November, but we may be certain that a very much greater amount of spread will have taken place than would have occurred during the late autumn and winter of a normal year.

Downy Mildew Disease.

Like Fiji disease downy mildew owes its chief importance to the fact that the leading P.O.J. canes P.O.J. 2878, P.O.J. 2714 and, in this instance, P.O.J. 213, are highly susceptible. Downy mildew is caused by a fungus and is spread from plant to plant by wind-borne spores of the fungus; thus it can spread considerable distances at a comparatively rapid rate.

Of the old varieties B. 208 was the most susceptible and as a result of its heavy infestation with downy mildew it has been necessary to disapprove its cultivation in the Lower Burdekin area for the purpose of protecting other varieties like E.K. 28.

The disease has now made its appearance in P.O.J. 2878 in the Mackay district and, to a less extent in the Bundaberg district. Since P.O.J. 2878 is only a minor variety in the Mackay district its further growth has been disapproved as it is feared that it would become a menace to other varieties. In Bundaberg, however, the infestation is lighter and, in addition, P.O.J. 2878 is now the major variety; accordingly every effort is being made to save the variety and a number of plough-out and disease eradication orders have been issued to farmers who have the disease on their properties.

Dwarf Disease.

The mysterious dwarf disease still continues to be found to a slight extent in the lower lying fields of the Rosella district of Mackay. As far as is know this is the only part of the world where this disease occurs and its origin, cause, and the manner in which it is spread remain a mystery. It is, however, a very destructive disease and Mackay farmers should be careful to see that they on no occasion obtain plants from this part of the district. The disease has occurred chiefly in the varieties P.O.J. 2714 (particularly), Malagache and Clark's Seedling, but the first two have now almost disappeared from this section of the district. Recent plantings have included Co. 290, E.K. 28 and P.O.J. 2878, but our observations indicate the susceptibility of both E.K. 28 and P.O.J. 2878. P.O.J. 2878 in particular seems susceptible under these conditions and, even if it were not disapproved as a result of downy mildew disease, its further growth would be undesirable.

Rind Disease.

Rind disease is one of the oldest known diseases of sugar-cane; its name is really misleading since the formation of pustules on the rind is one of the final stages of the disease. Prior to the appearance of these pustules on the rind it causes a sour reddish rot of the flesh of the stem and appears very similar to red rot disease. Generally it attacks cane some 6-8 joints above the ground and extends upwards for a few joints; thus the mid-part of the stalk may be rotted and dead while the top and butt appear sound. This disease was very prevalent last year in S.J. 4 in the Cairns area, 1900 Seedling at Mackay and standover P.O.J. 2878 in Bundaberg. Considerable losses resulted from the dead cane and reduced C.C.S. content.

The condition responsible for the widespread occurrence of the disease was the unusually dry autumn and winter causing over-maturity of the cane. The control of the disease lies in preventing over-maturity or false maturity and this may be done in part by change of variety, late planting, late applications of nitrogenous fertilizer or irrigation.

Autumn and winter weather conditions in the Cairns-Mossman district have been such as to lead us to expect a recurrence of the trouble this year in S.J. 4 but it is not expected that rind disease will again be prevalent at Mackay and Bundaberg.

Introduction of Varieties from Overseas.

The following varieties have recently been imported from overseas:—

31-1389 is an Hawaiian seedling, bred from P.O.J. 2878; it is reputed to be a rapid grower in the early stages, drought resistant, average sugar content and has a fairly hard rind.

B. 726, a Barbados seedling, which has shown considerable promise as an early-maturing cane in the better rainfall areas.

B. 2933, also from Barbados, is a mid to late season maturing cane suited to the lower rainfall districts of the island.

In addition, we have made arrangements to receive from the C.S.R. Company the following seedlings raised in the Northern Rivers of New South Wales, viz., 30 S.N. 225, 451, 673, and 874, 33 S.N. 1160 and 30 G. 1759. These varieties are nearly all resistant to Fiji and gumming diseases and thus they may be of special use in the southern districts although, of course, they will be tried in all districts.

CANE PESTS.

Northern Cane Grub—Damage in 1938 Season.

Infestations by the northern cane grub, the grub of the "greyback" beetle, were not particularly heavy this year. In the Cairns area the pest has not yet recovered from the severe set-back it received during the heat waves of 1934 and 1935; reduced infestation also occurred throughout the Johnstone district generally, where there was only one flight of beetles. Weather conditions favoured a big beetle flight in the Invicta area and the Lower Burdekin district, but dry conditions followed the hatching out of the young grubs, causing heavy mortality and, as a result, heavy grub infestations survived only in those fields which were subsequently irrigated.

On the other hand, owing to the short rainy season, the dry conditions intensified the damage done by the smaller number of grubs present and in a number of cases it was later found necessary to fumigate fields where the number of grubs per stool would not normally warrant fumigation. Consequently the area fumigated from Tully northwards (517 acres) was about the same as that fumigated last year.

In the Mackay area the amount of damage caused by this pest promises to be very much less than last year, when some 40,000 tons of grub damaged cane was delivered to the mills.

Long Flights of Greyback Beetles from Feeding Trees.

At times we find heavy infestations of cane grubs in fields although during the previous beetle flight period it was almost impossible to find a single beetle in the neighbourhood of such fields. Such a state of affairs existed this year at Greenhill Plantation when scarcely a beetle was observed on the feeding trees growing on or near the plantation. A search on the hills 1 to 1½ miles away revealed fair numbers on forest trees and these beetles were evidently responsible for the grub infestation which occurred at Greenhill. Such beetles would not have been touched by any beetle collecting campaign.

Fumigation in the Lower Burdekin District.

Following the relatively heavy losses from grub damage which occurred in the Lower Burdekin in 1937 the Pest Boards in that area decided upon a fumigation campaign for 1938. The Boards provided farmers with injectors free of charge and fumigant at reduced cost and also made available the services of temporary supervisors. As this was the first year in which fumigation had been undertaken the Bureau made available the services of Messrs. Buzacott and Knust in order that the supervisors might be instructed in methods of surveying grub infestations and conducting fumigation campaigns. A number of fields in the Kalamia and Inkerman areas were successfully fumigated. Naturally some small mistakes occurred, such as fumigation when the soil was too dry, but with the experience gained from this year's operations the Boards and farmers concerned should be in a position to take care of infestations in future years.

Control of Wireworms.

Wireworm damage to sugar-cane in Queensland is caused mainly by the lowland wireworm which, in turn, is a pest of appreciable importance only in the Mackay and Proserpine areas. It is quite the most important pest of cane in the Mackay area. This worm has a number of moults before it finally attains the beetle stage; in the early moults it is very sensitive to drying out and requires a water-logged soil in order to survive; later on it can withstand extremely dry conditions. The only satisfactory method of control is to have fields well drained before the commencement of the rainy season so that soils do not become water-logged and the young wireworms do not survive in large numbers. If suitable drainage is not provided then, if wireworms are present, it is very inadvisable to plant susceptible fields until the wireworms have ceased their activities—that is about late September. Many farmers object to such late planting, and it is freely admitted that it has many disadvantages; it must be emphasised, however, that in wireworm years many early plantings actually do become late plantings because of continued replanting and supplying and, in the course of events, are much more expensive and no more satisfactory than a single late planting.

Forecasting Wireworm Infestations.

It has been pointed out on innumerable occasions that the survival of wireworms in the field depends on the extent of the water-logging of the soil around February-March, when the young worms are particularly

sensitive to drying out. It follows, therefore, that the liability to wireworm damage is greatly dependent upon the length and intensity of the wet season. On the basis of a number of years of observation it is now possible for the Entomologist at the Mackay Station to forecast the probable intensity of damage, and farmers who have not provided adequate drainage may thus be guided in the making of a decision regarding late or early planting of susceptible fields. Following the heavy rainy season of 1937, warnings were issued in June of that year that damage would be extensive in undrained fields unless plantings were delayed until late September. This forecast proved quite correct, as did that of the previous year. The 1938 rainfall records indicated that relief could be expected and in the Quarterly Bulletin for 1st July, it was anticipated that in early planting damage would be confined to very low lying areas.

Trial Sett Plantings as an Indication of Probable Wireworm Damage.

The wireworm pest in the Mackay district is sufficiently important to warrant continuous attention on those farms where previous experience has indicated that damage by this pest is a possibility. In such places the best possible drainage should be provided prior to the commencement of the rainy season, but this may be supplemented by the planting of trial setts. Commencing early in the season such setts are planted at intervals in the field and later dug up and the eyes examined. The percentage of damaged eyes and shoots, taken in conjunction with the Bureau's forecast, may be used to determine whether earlier planting of that particular block may reasonably be undertaken.

The Rat Pest of Sugar Cane.

Damage to crops in Queensland canefields by rats has now returned to normal proportions in contrast to the great damage caused during the plagues of a few years ago. A special investigation of the habits of the various types of rat which attack cane in Queensland is now being undertaken by the Bureau; amongst other things the investigation is directed towards trying to ascertain the conditions under which these plagues occur and whether they may be forecast. During the course of the period April, 1937, to December, 1937, some 2,333 rats were trapped in the course of rat population studies and for the purpose of obtaining rats for the study of the effects of various poisons, &c. For this purpose a special live trap was designed and has proved very effective; the chief feature of this live trap is a false floor against which the trigger is set, the weight of the rat being responsible for the release of the trigger and trap door.

Rat Baits.

The attractiveness of baits to rats depends a great deal on the food which forms the base of the bait. Of the foods tested rolled oats proved much more acceptable to the field rats than any others; the order of preference by the rats was: (1) Rolled oats, (2) cracked corn, (3) whole corn, (4) wheatmeal, (5) whole wheat, (6) barley, and (7) bread. There is not much difference between the attractiveness of cracked corn, whole corn, wheatmeal and whole wheat, but barley is not very much

desired by the field rat and there is always a poor take of bread. Consequently if bread is used as a food base in a bait it should only be used with a highly effective poison such as phosphorus. No advantage was gained by adding linseed oil to baits; this oil attracts rats, and is excellent for attracting them to traps, but it is not an appetiser and will not improve the take of an unattractive bait.

Poisons Used in Rat Baits.

A large number of rats was caught and caged for the purpose of determining the comparative effectiveness of the poisons commonly used in rat baits. The following poisons were investigated:—Thallous sulphate (thallium), yellow phosphorus, strychnine alkaloid, strychnine hydrochloride, zinc phosphide, red squills, white arsenic, and barium carbonate. With the exception of the first three all must be condemned as being quite unsuitable for use in the poisoning campaigns as conducted in Queensland canefields. Of these three, phosphorus is the most poisonous and thallium least. Since a comparatively large dose of thallium is required to kill a rat it should be used only in conjunction with an attractive food base; it is considered that under present methods of distribution in Queensland the most economical bait strength is 1 part of thallium to 300 parts of food base. On the other hand phosphorus, being very highly poisonous, may be used on an unattractive bait base like bread since so very little needs to be eaten to kill a rat.

Comparing Different Rat Baits.

The tests described above were carried out in cages or in fields where the number of rats present was accurately known. The effects of the poisons were judged, therefore, not by the amount of bait taken, but by the immeasurably better test of the number of rats killed. This is a very important point and, in fact, the amount of bait taken in the fields is a very unreliable guide to its effectiveness. For example, it has been shown that there may be a comparatively large "take" of thallium treated grain without appreciable death of rats following; this is especially so in the case of weak baits such as 1:1000 thallium treated wheat. On the other hand the take of phosphorus bait may be so low as to be barely noticeable, yet it is so highly poisonous that there is a heavy mortality among the rats.

Rat Population Studies.

It very early became obvious that some method of estimating rat populations in the field was an important necessity. If we are to judge the effect of poison baits laid in a field then we must have some method of estimating the number of living rats present before and after the baits were laid. As stated above the observed "take" of baits may be very misleading; the rats might even carry off the baits to line their nests or, on the other hand, a bait which contains a fatal dose for one rat might be shared by five rats and they all survive. Two methods of determining rat populations were developed but the one now used is to trap rats in a "live" trap, chloroform them and place a numbered bracelet on the hind leg and let them go. These traps are set out at intervals through the field and a record is kept of the number of rats tagged. A certain number of these tagged rats are retrapped each night and from the proportion which tagged rats form of the total

number trapped in any particular night we may calculate the total population. The field rats, it might be mentioned, do not appear to be scared away from traps by the fact that they have been chloroformed

Rind Hardness and Rat Resistance.

It is found under existing normal conditions that a hard rind affords considerable protection to the larger barrelled canes. It remains to be seen, however, whether this would afford sufficient protection to reduce damage in rat plague years. Hardness of rind does not seem to confer any appreciable resistance on thin canes such as P.O.J. 213 and Co. 290; in these varieties, because of their thinness, even a small amount of feeding on one joint is sufficient to cause the stalk to break off at this point and fall to the ground.

The Giant Toad.

The giant toad has continued to breed rapidly in North Queensland, especially around Gordonvale, where they were first liberated. In this district there should be a large population of big toads, capable of eating cane beetles, towards the end of this year and consequently when the next beetle flight occurs we should be in a position to judge whether this animal is likely to be an important aid in the control of the cane grub. Reports indicate that the toads are breeding in the Isis district, young toadlets having been seen emerging from dams in that area.

Trashing for Beetle Borer Control.

Trashing has often been advocated for borer control and last year we carried out a series of experiments to test this idea on a sound basis. In these trials the cane was trashed more thoroughly than is the case in field practice but it was our desire first of all to test the value of trashing and later to go into the economic aspect. Cane trashed three times had much less borer control damage than untrashed cane and a somewhat higher tonnage was recorded. These trials have been repeated this year in order to study the effects of a less amount of trashing, of the type usually practised by farmers and, when these have been completed, later in the season, we should have a pretty good idea of what the exact effects of trashing are. At the present time our opinion is that trashing will certainly greatly reduce borer damage in places where the damage is great but, at the same time, we are also of the opinion that the same amount of reduction could more profitably be brought about by improved field practices such as have been outlined in previous reports.

What Gives Certain Cane Varieties Resistance to Borer Damage?

Each year trials of new varieties are carried out in order to test their resistance to borer attack. As a result of several of these trials we can now say that an erect, free trashing variety, with a medium to hard rind, will definitely be resistant to borers. Each of these factors is important and is necessary for high resistance. For example, by hand trashing Badila we may get an erect and trash-free crop, but it will still be moderately susceptible to borers on account of its soft rind, although less susceptible than if it were not trashed. Similarly free trashing and fairly hard rinded canes may become susceptible if they lodge badly. Q. 12 has as least as hard a rind as Q. 2 but yet an erect

crop may at times suffer a moderate amount of borer damage, due to clinging trash. Trashing of cane, contrary to general belief, does not increase the hardness of the rind but acts favourably because it removes the shelter which the borers like so much.

Rind Hardness Tests.

With a view to possibly simplifying the determination of borer resistance by cutting out the necessity for field resistance trials we have had constructed a small hand instrument for measuring rind hardness. This instrument has a blunt pointer which works against a spiral spring. As the spring is compressed the pressure increases and finally is sufficient tc force the pointer through the rind; when this penetration takes place the pressure is read off on a scale on the instrument. These readings can be made at a very rapid rate and the rind hardness of dozens of sticks can be determined in a day. By this means it is hoped that it will be possible to test large numbers of seedlings and obtain a good idea of their probable borer resistance without resorting to cumbersome field tests.

Fumigation Not Satisfactory for Control of the Frenchi Grub.

Experiments carried out with carbon-bisulphide, alone and mixed with para-dichlorbenzene or ortho-dichlorbenzene, failed to achieve a satisfactory control of the Frenchi cane grub. These experiments confirmed previous experience. Control of this pest is best obtained by observing the following points:—(1) Restrict ratooning and, if possible, fallow for a year after ploughing out; (2) plough infested land during the summer, when the grubs are feeding in the upper layer of soil, so that they may be killed by ploughing operations or exposed to the attack of birds and other insect eaters.

New Zealand Blue Lupin as a Winter Legume.

By N. J. King and D. R. L. Steindl.

IN the October, 1937, issue of the Quarterly Bulletin were reported the results of a trial with New Zealand Blue Lupin as a winter cover crop at the Bundaberg Station. So successful was this first experiment that a further planting was made during the past winter. The seed was planted on the 7th April, 1938, on an experimental block which was undergoing a long fallow.

On this occasion, 2 bushels of seed per acre were sown, with the object of obtaining a heavier crop. The field was harrowed in two directions after broadcasting the seed, and an excellent germination resulted. The double harrowing appears to be necessary to ensure coverage of the large seeds. The ideal winter rainfall of this year resulted in unchecked growth right through to time of flowering of the crop, which commenced about the end of August. By this time the crop was 5 feet 6 inches high, and had produced a heavy, erect growth of succulent material. Ploughing in presented no difficulties, and with a single-disc plough a good, clean cover was obtained (*see* Fig. 22). The crop was in full flower and some young seed pods had already formed, but the plants were still remarkably soft and succulent, with no sign of woodiness in the stem.

When the crop was being turned in the plants were found to have numerous large bacterial nodules along the tap root. The bacteria in these nodules would naturally be expected to "fix" large quantities of atmospheric nitrogen, making it available to the plant, and thus increasing the store of nitrogen in the soil when the crop has decomposed.

Fig 22.—Illustrating the heavy crop of Blue Lupin on the Sugar Experiment Station, Bundaberg.

At the time of ploughing in (7th September), small areas of the crop in different sections of the field were cut off at ground level and weighed. These weights, when calculated to tonnage, gave the very good average figure of just over 20 tons per acre of green matter, with no allowance for the underground portion of the plants. The farmer will recognise the humus-forming value of such a mass of succulent material, and at the present time there is available no other winter-growing crop which will produce such a large body of growth, and which will decompose so rapidly, while at the same time enriching the soil in nitrogen.

In order to determine the dry weight of the crop, and the amount of nitrogen added to the soil by it, several plants were cut and weighed green, then dried out and nitrogen determinations made. These showed the following highly satisfactory values:—

Weight of green crop	20 tons per acre.
Weight of dry crop	4·1 tons per acre.
Nitrogen in dry material	1·05 per cent.
Nitrogen contained in crop	97 lbs. per acre.

The quantity of nitrogen in the crop is, therefore, equivalent to an application of sulphate of ammonia at the rate of 485 lb. per acre.

Moreover, it is in a form which would become available to the cane crop at a gradual rate during the ensuing few months after the rotting is complete.

A prolific crop of New Zealand Blue Lupin was also grown this year by Mr. C. Colquhoun, manager of Windermere Plantation (*see* Fig. 23). The seed was broadcast at the rate of 2 bushels per acre, then harrowed in and rolled. Planting was carried out on the 26th April, and the crop was ploughed under during the first week in September. By the time it was in flower it had reached an average height of 4 feet 6 inches, but was over 5 feet high in places. The growth was very dense and succulent, and no trouble was experienced in ploughing in.

Fig. 23.—Showing a portion of the crop of Blue Lupin grown on Windermere Plantation.

Although the seeds were not inoculated the roots were found to be bearing large Rhizobium nodules similar to those found on the crop grown on the station. This would indicate that a suitable strain of the bacterium was present in the soil.

Another crop grown on a nearby property, however, was a comparative failure. An examination of the young crop showed that a large proportion of the plants were yellowed and wilting, and many had died. The roots and lower portion of the stems of these plants were found to be attacked by a fungus which was killing the tissues. This fungus was apparently very plentiful in this particular soil, or was favoured by the heavy rains during the autumn, but it is unlikely that it would become a general menace to lupin crops; it is thought advisable, however, to mention the occurrence of the wilt in this particular planting.

This crop appears to be particularly suitable for inclusion in a long-fallow system, but the ploughing in of a winter-grown leguminous crop naturally dries out the soil, and the use of such crops in dry areas is not advocated unless it is intended to delay planting until autumn, or at least very late spring.

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